METHOD IN PREHISTORY

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PREFACE.

This is the first publication of the South African Archaeological Society, which started its first months of life as the Cape Archaeological Society, a title under which no publications have appeared. It is our present intention to complete a series of similar handbooks covering a variety of aspects of South African Prehistory. These will be issued annually, and will be illustrated as funds permit. They will probably appear in the following order and under these titles:

Part II.	Bibliography and Commentary.	Due in 1946.
Part III.	Survey of Implement Sites.	Due in 1947.
Part IV.	Paintings and Engravings.	Due in 1948.
Part V.	Prehistoric South African Types.	Due in 1949.

Should we find reason to discard any of these subjects or change their order, we shall do so. If the series proves successful, we may continue it under such additional titles as: "Survey of Associated Faunal Remains", "Survey of Climatic and Human Geography", "Survey of the Zimbabwe Complex", "Prehistoric River Systems", and so on. By this means it is intended that the study of archaeology in South Africa shall have a firm foundation on which to build, and that individuals and institutions here and in other countries, may have a source-book or compendium at their disposal, to which they may turn for authentic information on our sub-continent.

The present volume in the series embodies personal lessons learned from practical experience in Britain, France, Spain, Algeria, Tunisia, in other European countries and in all provinces of South Africa, over a period of twenty-five years. This is the first time that a work of this scope, directed to meet the needs of students in the South African field, has been published.

Works covering the methods and discipline of any subject are rare, in spite of the fact that they are of more immediate importance to the student than the discoveries of others. Once method is understood and the discipline of our science comprehended, the student should turn to field-work under the close guidance of experienced workers with widely differing points of view. Then, and only then, can he turn his mind to the publications of others with a clear understanding of the validity of their inferences, and the labour entailed in making reasonable deductions from evidence.

METHOD IN PREHISTORY.

Figuring the nature of the time deceased,
The which observed, a man may prophesy
With a near aim, of the main chance of things
As yet not come to life; which in their seeds
And weak beginnings lie intreasured.

Such things become the hatch and brood of time.

II Henry IV., III. i.

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I.

INTRODUCTORY

> If you bear me hard,
> Now, while your purpled hands do reek and smoke,
> Fulfil your pleasure.
>
> *Jul. Caes.* II. i.

This introductory chapter is intended to simplify the rest of this handbook. As we go on we shall become more technical in many different fields of research. Take it slowly. Study each chapter for an hour or so at a time. At the end you will find an index and bibliography. These are the most important parts of any book, and should constantly be turned to for references.

Interests vary widely. We shall mention a few, but there are dozens more, which will provide scope for many very different types of mind. I believe it was Reginald Smith who once said that he had drawn every finished implement that had ever reached the British Museum; in contrast I have met many archaeologists who have never drawn an unnecessary line. Some people are interested in fauna and the climatic conditions that these animals suggest. Some seek diligently for proofs of changes in climate; others for indications of man's evolving mentality as seen in his aesthetic life, his burial rites, his attempts to express such things as number, shape and form, or in proofs of cooperative action in hunting, fishing or in building. Others again are most interested in man's early beginnings, anything less than a few hundred thousand years leaves them bored and apathetic, while nothing pleases them more than some early not-quite-human stage. Some prefer a detailed study of the way implements were made, and the discernment of technical themes running like threads through man's story, proving the continuity of man's inventive powers, the development of one improved invention from another. Others are interested in geographical distributions over wide areas, and look for proofs of migration of people along river beds, through gaps in hills or along coastal belts. Others are photographers who

find in archaeology an outlet for their own art. They use colour photography to reproduce cave paintings, and strive to get the correct lighting for implements and rock engravings. They turn their photographs into transparencies, lantern slides and prints. Then there are those whose interest lies in man's physical development and evolution: man as an evolving animal, but always in relation to his cultural achievements. There is ample room for all of us. We cannot all captain the ship, we cannot all act as steersmen. The greaser in the engine-room is as necessary as the stoker or the wireless operator, while even the cabin-boy releases others from drudgery so that they can do other things that are also essential.

Get a simple book or two on prehistory. Among the more recent are Leakey's *Adam's Ancestors* and Dorothy Davison's *Men of the Dawn* (Watts). Read them through carefully, then take a pencil and jot down the points that interested you individually. This will help you to fix in your own mind what your personal approach to the subject should be. Whatever that approach, you will have to learn something of the entire field, but your angle will be personal and your stresses and observation will be individual. Some minds work mainly through the channel of the ear; they are tidy, impractical and precise. Others work largely through the eye; they are untidy, practical and tend to have a very wide though often inaccurate knowledge. Most of us lie between these two extremes, but our fields of interest and the channels through which we naturally learn are very varied.

Sir Arthur Keith once said that modern man uses only about one-tenth of his thinking brain, and it is true that most of us deliberately shut off the acquisition of new thoughts by refusing to analyse and to make new judgments. The detective novel is a soporific, a drug to be taken and then forgotten; but now and then we find it used by a reader as an exercise in clear analysis and logical deduction. To take up prehistory is to live the part of a detective in real life. Legitimate deduction and logical reasoning are the materials of which archaeology is made, and not the squirrel-like acquisition of chipped stones and animal teeth. As in the detective novel, so in prehistory, the body must not be touched until the experts can deduce the maximum possible evidence from its position and associations.

Here is an implement. All that is obvious about it is that it is made of stone. Even the fact that it has been shaped by man needs to be pointed out. To the ordinary man it has no further interest. But let us look at it more closely. It conforms, in the way in which it was shaped by chipping, to a pattern that we know to have been typical of the technique of a certain period. Perhaps it shows trimming on both faces, or perhaps it has a smooth shell-like cleavage forming one face, while the other face is trimmed. If it is a flake it may have been struck from the side so that it is short and wide; or from one end, so that it is long and relatively narrow. If we look for the little bulb (like the hinge of a shell) that marks the point of percussion that struck the flake from its parent core, we shall see where the blow fell. This bulb has its origin in the "striking platform" that forms the butt of our implement. The platform may be smooth and flat, or it may be made up of little scars left by the removal of half a dozen chips, so that the butt is faceted.

Now let us look carefully at the edge of the implement, the thin blade-like edge that marks the release of the flake from the core. We may see that it has been retouched by means of numerous little taps, each of which took off a minute flake, to yield a sawlike cutting edge. This sort of working is typical of a retouched implement. The flake may have been of suitable shape and size, selected for its form, and this simple retouch may be all that was needed. But it may have been a flake delicately chipped and shaped by careful flaking, so that the form of the original blank can no longer be even guessed at. It has achieved a new and pleasing symmetrical form that makes it more useful as a tool.

There is much more of interest in this flake. Feel the flake scars carefully, and look at them towards the light so that you can deduce from the curve of the fracture the direction from which each of the blows that shaped the stone was struck. This should give you some indication of the technical knowledge involved, and what the maker was intending to do. How uncertain early man's attempts were can be gauged from the fact that in Australia Roth observed that two hundred flakes had to be discarded in the attempt to get a single implement, similar in technique and form to what we in South Africa would

call "Mossel Bay" type, a neat triangular point that is still used in parts of Australia. If two hundred blank spalls are rejected for such a simple tool, in which only five consecutive and well-placed blows produce the finished tool, how many hundreds of rejects must we expect if a more complicated implement was intended? The foolish habit of naming and describing every little flake or trimmed stone on a site is as futile as naming each angle of bent nail that is to be found in a carpenter's workshop, or developing careful recipes for burnt cakes. Learn the implement types, and learn why they are regarded as conventional forms. Retouch is the best criterion.

Burnt cakes or bent nails have their uses, and they can well be called "habitual rejects or discards". They show the kind of mistake that was likely to happen. In their proper perspective cakes may prove that a people had access to rice-flour and coconuts, while a bent nail will prove that straight nails were known even if they were only imperfectly understood. This recognition of "habitual discards" is therefore important — obviously more so in prehistory than in any other subject, as we are seldom certain which is the finished tool.

Now let us look at the physical condition of the implement. It is a clean new flake, with sharp edges and ridges, and we can deduce that it has been protected from the natural destructive agencies that would attack it. The chances are in favour of its being relatively recent. But this other flake is finely pitted all over, so that light and shade will show up as though it were an under-exposed photograph. The edges and ridges are smoothed as though it were not quite in focus. This is the effect of sandblast — the long bombardment of the stone with minute sharp particles of sand carried by high winds.

Here is one that is consistently smoothed off wherever there is a ridge (sometimes called an *arris,* though ridge is a usual term) but is not affected between the ridges. Here and there we see crackles or percussion marks on the surface of the stone. This stone has been in running water, and probably formed part of a gravel deposit. By a "gravel" I do not mean a collection of little pebbles made of sand cemented with iron salts, such as we use to make a gravel path; I mean a spit of pebbles and boulders left stranded at a bend in a river. The

river may have cut through this gravel spit or bed, or it may have covered it up, or it may have cut down and left the gravel isolated as a terrace on the slope of the hill. Whatever may have happened since the river deposited it, it is still left to form part of an old "fossil river-bed". It is the skeleton of what was once a living river.

Here is a very typical brownish stone. It is broken at one place, and we can see that the underlying stone was a deep jet black. It is for all the world as though the stone had been baked so that a brown crust formed on the outside. That is chemically exactly what happened, though the process is not due to heat. The iron salts in the stone have oxidised and have formed a skin of ordinary rust, mixed with silica and other salts, to form the "patina" on the stone. Patina merely means a cookie or little cake. This patina in dry conditions is usually made up of iron rust, or, in some cases, as at the Victoria Falls, it may consist of a silica glaze or varnish. Both suggest that the stone has been affected for long periods by dry climatic conditions. In Europe patina may be due to calcium salts, or to a bleaching of the flint, which are products of quite different climates.

Here is another stone on which only fragments of patina remain, but through these we can see the underlying colour of the somewhat bleached rock. The patina has been stripped off by water action, which has rolled the stone along the stream-bed and peeled the patina from it. This suggests that, after years of dry conditions, a period of increased rainfall has set in, so that the local stream has risen above its normal banks and caught up this stone. The increased rainfall may have lasted for a season, a century, or a thousand years — that we cannot learn from a single specimen. It needs a careful study of an entire river system to learn the extent and duration of such a climatic change.

Here is a sandstone that has almost turned to coarse sand. If we crumble it, it breaks away like coarse sugar lumps. Such a material would be useless to primitive man. It has been burnt, either in the hearth or by recurrent grass-fires. Certain elements in the cement binding the sand into a rock have been changed so that they have lost their cohesive powers.

Here is another that has cracked and split into curved flakes that leave bulges on the stone from which they split off. This

has been affected by considerable heat, followed by sudden cooling — rain falling after a heat-wave. It is the same thing that happens when ice is put into a hot tumbler, or when hot water is put into a cold bottle — the result of the battle between expansion and contraction.

That handful of stones has taught us a lot: but we have not said a word about the real essentials. Where did they come from? Were they from river gravels; or were they found lying on the surface of river gravels, after having been made from the older pebbles and boulders that formed the gravel? Did they come from the surface of an open valley or from a wide plain? If so, had they washed down to their present position, or were they made on this very spot? This should be easy to see from the distribution of the implements and from the slope of the land.

On many sites we find that a large number of flake tools are clean and fresh, while scattered about among these are as many that have been heavily patinated. Let us make a collection from a site of this sort, and divide the tools we pick up into two groups: those affected by wind action and oxidation, and those with fresh physical condition. We look through the two groups carefully for points in technique such as we discussed earlier, then we put down two lists of the characteristics, something like this:

ANALYSIS	A	B
Primary:		
Flakes (total)	100	100
Faceted butts	84	1
Plain butts	12	79
Uncertain	4	20
Side-flakes	10	30
End-flakes	70	60
Uncertain	20	10
Secondary:		
No secondary work	69	51
Trimmed along side only	19	3
Trimmed all about edges	0	18
Trimmed across one end	2	17
Odd worked flakes	10	11

Trimming:

Upper face only	14	49
Under face only	4	0
Both faces	13	0

We can now express the result in words, to see what the essential differences between the two groups appear to be:

A. A number of flakes showing (in the trimmed series) a preponderance of faceted butts; trimming along the sides of flakes, generally on the upper surface, though a few instances show working on the under face, while some are trimmed on both faces. Heavily patinated. Flakes average 3″ in length.

B. A number of flakes showing plain butts almost exclusively. Many of the trimmed flakes have been worked across the end, or all about the free edges. There are no instances of working on the under face. Physical condition fresh and clean. Flakes average 2″ in length.

This yields two very different pictures, and as we have taken a fairly large sample we can reasonably say that these represent two different periods in man's cultural aims and achievements, and that A is an older series than B. Now we are getting somewhere. On other sites we can extend this knowledge. There are many other characteristics shown by stone implements that can be employed in an analysis of this type, most of them to do with the tricks and methods used by the makers to get the shape they wanted: that is, technique. We may be able to differentiate three or even four periods from a single site; but it is of no use to compare chalk and cheese. The materials used on the site must have been the same to permit us to make a reasonable comparison. This means that in addition to our uncertain cases, we may have a number of instances in which the material used by early man was so different from the comparable series that much of it has to be set aside as incomparable. If patination is extreme, these can reasonably be taken back into their proper series, but if it is relatively slight we must discard the unsatisfactory evidence, unless, of course, there is reason to add a few back on technological grounds, etc.

By taking large samples we can form a "scientific generalisation" that approximates to fact. The smaller the number of

instances, the weaker our case. If we were to take a single boy as a specimen, we might say "All boys have red hair". This is not random sampling, it is selection. If we take a sample of 100, we can with far greater truth say that "Most boys have thatch-coloured hair". This would again be true only if the sample were taken at random and not selected on the grounds of the old school tie or political party. If the question of race were to arise, we should have to add the rider to our statement that this was typical only of the racial group selected. If a native school were used for sampling, the hair colour would be black. These very simple and logical statistical approaches are essential to the analysis of an open site.

Just in the same way that the question of area may arise when we discuss skin colour and hair colour, the question of distribution of implements scattered over an area becomes important. We can discuss this shortly. If you look at any camping-site, you will observe that people tend to choose very different places to assemble and talk. Depending on the wind and the weather, they will naturally dispose themselves differently. In a hundred years' time we shall find that to-day's great trees have died, while their saplings now stand towering above a different part of the camp ground. The grass, once so green here has eroded, and a new patch has sprung up fifty or a hundred feet away. New campers will naturally dispose themselves in completely new patterns. The same thing has happened through the ages. It is only in cases where some great sheltering rock has remained firm that these camping places have tended to stabilise. It should be possible therefore to square out the ground, and to find some sort of differential distribution of the remains of these camps. In all probability squares ten yards across will suit most areas. If the areas are larger, related to wide pans or open plains, up to a hundred yards will serve. Each such area should be carefully collected, and lists made very like that given above, allowing for other points in technique as well, depending upon the the series found. This is called "zoning" an area. By careful comparison, we can deduce the disposition of various camp sites through the ages; but what is more important, we can get another view of man's culture, so that, in addition to differences in the figures we get as our totals, we can add

distribution. Zoning is the local application of true survey methods, and does not differ from those methods in its essentials.

In zoning an area, care must be taken to conform with the lie of the land. If we follow a river, we may find it best to take strips of bank twenty-five yards long from a fixed point. These are numbered according to their bank and position, L1, R1, L2, R2, and so on, and collections are made in separate paper bags, or in cloth bags if these are available. When you return, sort each bag, and from the contents of each develop a series of lists like those given above. Even if there is no difference discernible in the areas, this is in itself evidence. Lay more stress on technical elements than on implement types. If in a single area you find that people employed the same methods of flaking, that is more important than the discovery of a perfect lance-head in one zone and a handful of "oak-leaf" types in another. They are most likely to be different aspects of the same culture. Always apply your evidence to commonsense standards. If you were to find a chair-leg in one corner of a garden and a table-leg in another, you would hardly deduce that there was evidence for two different periods of culture. If, on the other hand, a piece of Crown Derby were found alongside a native beer-pot, made by a very different method, such a deduction could reasonably be made.

In collecting implements from open-air sites, which is all that most of us are permitted to do, it is absolutely necessary to keep strictly to certain rules in order to obtain the most complete data. Enough has been said above about zoning a site. It was suggested that implements should be collected in paper or cloth packets. The whole idea is to keep zones separate, or to keep sites separate. It is useless to divide your collection up between packets in the field if they are to be dumped into a single box when you get home. The first rule is, mark every specimen with waterproof drawing ink.

Every collector has prejudices in favour of certain tools. In zoning an area, pick up every implement and flake in your little patch. If it is obviously useless (and this takes a little time to learn), put it in your pocket, and eventually dump it all in a single heap in the centre of your zone. This makes it easier to come back and check the material for future evidence, and it

also saves picking up the same stone two, three, or four times over.

Finally, if you are working as part of a team, hand in all your finds to the team. It is irritating to the acquisitive jackdaw to have nothing to show his intimate friends, but that can be got over by making careful sketches of your better finds in pencil before they go up for their final sorting. This can be done when you mark your specimens. Unhappily the tools you are sure to want are just the very ones that provide the most interest and evidence, if they form part of a large carefully collected set from a single zoned area.

If a return is to be made to the same site, marks must be left to show where zones ended, and these should be marked on an accurate large-scale map of the locality. In South Africa most of the country has been accurately mapped, and after the war it should be possible to get sets of local maps at reasonable rates. These should be used carefully, and local sketches traced from them in coloured pencils or inks, or enlargements made of important areas. This saves the maps from destruction in the field.

Those of us who (like myself) keep untidy desks will long ago have learnt that the older work tends to lie at the bottom and the more recent on the surface. This is simple stratification, and it has been happening since the world began. Discarded things tend to build up in layers so that the oldest gets covered over by later material. Just as you may find an unanswered letter dated three months ago at the bottom of a pile of work and a new letter at the top with yesterday's date, so we can "date" stratification. You may find only three dates in the pile: early January, mid February, and late March, but you can call these fixed points 1, 2, and 3, and the material that lies between can be described as lower and upper pile. You may have a shrewd suspicion that certain things happened in a certain order between these fixed points. "This must have been written towards the end of January". It is a guess, but a limited guess. Very often we can link our guesses with something quite different. Here is a piece of paper on which ink has been spilt, here is another from the next pile with a similar stain. This is evidence. Those two sheets are contemporaneous. They both

lay on top of their piles at the same period. And what about the stain? That dates from my son's short holidays. This limits the date even more exactly. Everything can now be dated in relation to the school holidays. All this type of deduction we call by the name "chronology", the study of time, the study of the order of things. In archaeology we relate periods of human history in a definite order, then we try to relate this order with something outside the range of human activity, something with a wide effect, like a climatic change, or a change in sea-level. These are problems that are studied by geology, the science that deals with the phenomena that brought about these changes in the earth's surface, as they are understood from a study of rocks, soils, and other deposits. The geologist eventually has to turn to the meteorologist, the man who studies climates. "We have evidence here that over a certain area there was once a marked increase of rainfall, or of snowfall. Can you tell us the general climatic arrangement that must have given rise to that?" The meteorologist might reply that either of two causes could produce the same result, depending upon the exact balance of natural forces. It may then be possible to narrow the issue by discovering further evidence, sufficient to cut out one of these two alternative causes. The work has gone a step further. The meteorologist finds that other evidence from a very different area shows that, at a certain date, causes such as he deduced must have been in existence. He can then tentatively date the two occurrences in the two areas as being of the same period.

Here is the simplest possible example. There is a change in sea-level observed at Mossel Bay. An identical change is found at the Cape, then on the Abyssinian coast, then near Casablanca. It is obvious that these changes were manifestations of the same thing. This is not just a local upheaval of coastline; it is a general subsidence of the sea. This gives us a "horizon", like the hour-hand of a clock. We can call it the Beach Horizon. Everything along the whole continental coastline can eventually be dated as pre-Beach or post-Beach.

So much for our introductory chapter. Remembering that you probably have used only one tenth of your thinking brain so far, turn on to the following more difficult chapters, and apply yourself to thinking out the various problems with care.

Believe nothing; that is, accept nothing on trust. That is the basis of the scientific approach. It is the sifting and sorting of absolute truth from the vast accumulation of probability and surmise. Far more than half the things that we believe are probably untrue, and a vast proportion of the remainder depend upon no real proof. This does not mean that we can widen our field of belief, but it does mean that we should sift theory from fact, and try to keep the two fields of thought separate.

Take the example given on the previous page. The geologist showed that certain conditions proved to have been present in a given area. He judged this from exact conclusions drawn from the deposits. Next he handed the evidence on to the meteorologist, who was (in this instance) by no means so sure of himself. Here was a question of delicate balance between temperature, cloud cover, prevalent winds, sea temperatures and currents, sun heat, earth radiations, barometric pressure, the humidity of the atmosphere, and the position of the poles at a particular time. If one of these estimates were wrong, it might even be possible to get conditions completely reversed in an extreme case. While he can gauge and measure all these factors to-day, when it comes to climates of ten thousand years ago he can only deduce what conditions must have been. He is dealing in terms of circumstantial evidence, and, while this may in certain instances be enough to hang a man, it should never be regarded as a proved fact.

Now continue reading. If you are interested primarily in surface geology, get a good book on Geomorphology. An excellent example is L. C. King's *South African Scenery*. Marr's *Scientific Study of Scenery* is slightly simpler, but does not deal with the local field. Most works on archaeology, especially those of the less advanced sort, will give you some idea of how implements are made and what they look like. After studying these, go to the nearest museum, or to another enthusiast, and see and handle stone implements for yourself.

II.

THE SCOPE OF PREHISTORY

So every scope by the immoderate use
Turns to restraint.
Meas. for Meas. I. iii.

Approaches

Vaysonne de Pradenne has pointed out that, philosophically, there are two possible avenues to the problem of prehistory.

A. The prolongation of the historic and archaeological fields

Before the first documents of history appear there is always a period from which memorable events and the facts most closely affecting the social group are preserved as an *oral tradition*. This is often crystallised into a rhythmic or repetitive form to beautify it and make it more easily memorable. Examples are found in our own folk-tales and folk-songs, in the Xhosa *izi-bongo,* in Homeric poems, in the Scandinavian sagas, in the fairy-tales of Ireland, and so on. These have virtually passed into written history. Similarly, the survival of early historical customs, beliefs, and even techniques, into quite different social conditions sometimes provides clues to past history, very much in the same way that vestigial survivals may yield a clue to the story of evolution. The use of mistletoe as an emblem of fertility; the employment of stone or wooden knives for circumcision or for killing a sacrifice, and the belief in the "profanity" of metals that results; surviving elements and patterns of witchcraft and early religion; the remnants of past techniques in woodwork, bookbinding, pot-making, and so on, all link with the past of a people.

Language may yield evidence of contact through trade or inter-racial mixing. The introduction of Hottentot words and clicks into Zulu and Xhosa, the survival of Romany among the Gypsies and of Celtic among the Welsh, Irish, Scottish and

Bretons; the introduction of an "aristocracy" of polite words from Norman French into Anglo-Saxon; the survival of Malgasy on Madagascar, and other evidences of the same sort, give us odd and interesting clues to major contacts and distributions of earlier times.

Excavation is carried out in the field to fill in the gaps in our historical data. The abilities, arts and methods of each little-known period are brought to light. What is more important is that in the process of collecting this data a new series of facts has been discovered, and so a new science has been founded, with methods and approaches of its own. Archaeology, that was created to augment history, now becomes independent and studies the evidences of human endeavour in the periods that immediately precede history.

In the countries of the old civilisations, this procedure from the known to the unknown first attracted students. In Greece, Rome, Egypt, Troy, Crete and later at places like Zimbabwe and at Mapungubwe, this approach has been preferred. How these methods can be made to act in civilisations that have had no history may be seen in Mexico and Peru, and more clearly in Mesopotamia and the Indus valley. This approach is essentially legitimate, and only fails to convince when major climatic changes, changes in population or in the mode of life, show that conditions then cannot be analysed in terms of conditions as they exist to-day. The archaeologist follows the will-o'-the-wisp of origins, always receding a step further away, and persistently eluding him.

B. Search for ultimate origins, through other sciences

In scientific attempts to reconstruct soil changes, stratification, land-forms and the history of climate, and attempts to understand the evolutionary changes in the zoological and botanical kingdoms, the appropriate sciences are eventually forced to bring man into the picture. He is a factor in these changes, or he is found as a fossil in certain deposits. He appears therefore in one of two lights: either as an evolving physical being, a field for comparative morphological research; or as the bearer of an evolving mentality, to be understood in the light of

his achievements and activities, his ability to cooperate and to invent, his powers of maintaining a social structure, the development of his arts and his beliefs. These two aspects of man become, quite simply, Race and Culture. It is this approach through already existing sciences that will yield us the greatest documentary evidences for the earlier phases of man's story, while we are still at liberty to turn to the methods of history and pure archaeology for evidence, and to ethnology for comparative detail relating to more recent peoples.

Some laws of science

Certain fundamental laws are inherent in the scientific approach to any subject, and we may glance at some of these before going further. In any approach to evidence it is essential to work from the known to the unknown; that is, after theory has been sifted from the small residue of fact, we are left with a firm foundation for the further deduction that can be extended within its own legitimate field to interpret our new knowledge. We must consciously observe the difference between theory and fact.

A second law may be stated thus: of any two theories, the more feasible (i.e. the one covering the greatest number of known facts) is to be preferred. Then of course there is the basic geological law known as the Law of Existing Causes. This was first formulated by Geikie and was fundamental to his work in which he showed clearly that existing land-forms and those left behind from the earliest geological times were both the products of the same general causes, and that they were essentially similar developments in a process that is still in action all about us. It was this same law that underlay Charles Darwin's "Origin of Species". He showed that all the known facts of evolution could be covered by a theory that postulated processes of selection that are still at work all about us. Much of his most interesting work was undertaken in a few square yards of his own lawn.

Using the same methods, we may study glacial action as it occurs to-day in Scandinavia and in Canada, or in Russia and Siberia. We can study the development of river systems from our knowledge of the Somme or the Vaal; from the first erosion

of a donga to the Rivier Sonder End. We can study our river systems under divers conditions, the story of a river flowing through the arid plains of Egypt, or the tropical forests of the Amazon and Congo, or through frozen tundra in Siberia. We can see sub-aerial action in regions of high wind, the blizzards of Canada or the hurricanes of America, or even in the steady winds of the Cape of Good Hope and the Karroo. Erosion and soil change can be seen all too clearly in parts of the Union. In South Africa, changing flora and the ecology of plant life provide us with immense fields. The results of grass and forest fires, the habits of game, their distribution, endemic diseases, and so on, can all be observed about us to-day.

By extension this can be reapplied in the field of prehistory. The same factors that exist to-day existed then, and they produced the same results. We can study the effects and from them we can deduce the causes and their intensity, and the study of prehistoric deposits thus leads us to a picture of like causes acting in a particular area at a particular time.

When we are dealing with biological species we must be more guarded, but even here certain legitimate deductions can be made. We know for instance that certain animals prefer warm climate, open grasslands, deep forests, or light bush. We also know that some animals by reason of their structure (the vast horns of *Bubalus bainii* or the long neck of the giraffe) could accustom themselves only to certain conditions. The buffalo could not have passed thick forest; the giraffe needs bush country. But we must not generalise from particular instances. The discovery of an individual giraffe or one specimen of the buffalo would not necessarily prove very much. The specimens may easily have died as a result of meeting adverse conditions while migrating from one area to another, or may be the transported products of the hunter's kill. A collection of bones representing the total fauna of an area, and a careful listing of the proportions of each type, will always yield an excellent picture of existing conditions if it is interpreted in the light of geological deposits. The breccias (bone deposits) of limestone caves should be made to yield us just such a series of pictures before they are turned into lime by the burner. If we know the conditions existing in one small part of the country at a particular

time, the science of meteorology has so far advanced as a result of the war, that it is possible to produce a general picture of the conditions existing over a large part of the sub-continent at the same period.

By analogy we can go further: we can deduce the spread of grasslands from the abundance of zebra or horse bones, or we can deduce the extension of ice-fields by a study of the distribution of the reindeer. But as our comparisons become less exact, we must be more careful. The mammoth, the woolly rhinoceros, and the sabre-toothed tiger do not necessariy imply the climatic conditions of Africa or India. We learn that many specialised animals were adapted to conditions very different from those under which their cousins may exist to-day.

Interpretations of the uses to which implements were put by prehistoric man can be deduced, not from the civilised city dwellers, but from analogy with the Eskimo, the Australian Aborigine, and our own Bushmen. These provide us with a guide to the study of technology, the abilities and needs of the simple hunter, the sort of protection that man needs against nature. In a few instances where tangible evidences of art, funeral customs, fetishism, magic or nature worship still exist, we can make cautious and limited deductions to learn something of the social and religious life of prehistoric man. Here again caution is essential. In comparative works the similarities have been stressed at the expense of differences, but while a psychological similarity may be apparent throughout mankind, the ways of expression are various. Even a superficial study of Spencer and Gillen, or of Porteus on the Australian Aborigine, and of Hahn, or Bleek and Lloyd on the Hottentots and the Bushmen at the Cape, will show a vastly different approach by each people to such fundamentals as language, mythology, natural phenomena, birth, initiation, death, fertility, and indeed everything important to man. In the Australian and the Bushman and the Tierra del Fuegian we have the end-products of three cultural traditions and migrations so different from one another, and so far removed from the comprehension of the European mind, that no one could be deduced from the study of the other two, or from knowledge at our disposal. None of them would appear to have much relation-

ship to, let us say, the Eskimo, who have a very different outlook on life and death. If we make comparisons, these differences become more important than any apparent similarities.

There are other fundamental laws of science; for instance, things that are equal to the same thing are equal to one another. That gives us the fundamental law of dating deposits in relation to geology or climate. But there is a very important pitfall. Things similar to the same thing are not necessarily similar to one another. A hippopotamus, a rhinoceros, and an elephant are all "similar" in having heavy hides and four legs and in being mammals, but there the identity ceases. The same may be true of dating, climatic conditions and a hundred and one very important assumptions of identity based only upon a superficial similarity.

The field of prehistory

It would seem best, as de Pradenne has suggested, to include in the field of prehistory "all the studies relating to man's origins, and to phases of his development, morally and physically, before historic documentation, and in every region of the globe." This virtually means the study of man in relation to changing environment, changing flora, fauna and climate. It means the study of man's physical evolution, his differentation into racial types, and the study of his intellectual growth and moral development in so far as these can be recognised in the advances he may have made in simple industry, art, social organisation, religion and morals.

The student should therefore know something of Quaternary geology, comparative zoology, botany, palaeontology, human skeletal anatomy, physical anthropology, ethnology and soil-chemistry. In fact he need only know enough to interpret the findings of a specialist correctly; but it is essential that he should understand the value of his finds, and comprehend the scientific approach, and the approaches of such subjects as history, geography, ecology and sociology. He must employ his material without suppression and without stumbling into the pitfalls of ignorance. His knowledge, while it need not be great, must be directed. A knowledge of river development, comparative

odontology (the study of the teeth), essential human types and their measurements, horn types, molluscan groups, etc., should all be known or understood sufficiently for the worker to make some use of books of reference on each subject. This kind of knowledge is needed to allow the fieldworker to recognise what is sufficiently important to submit to a specialist and, when that specialist has given his considered opinion, the archaeologist should be able to make deductions as to climate and environmental changes such as can be drawn from the sum total of his evidence. He must understand just how much and how little the specialist is intending to convey.

There are specialists in every village. Every dentist has a knowledge of comparative odontology and can identify the genus of teeth, even if the species is uncertain. Similarly, any doctor is able to give a considered opinion on the species of mankind, and is able to carry out basic anthropological measurements. These are the men who should be consulted locally.

Definitions

The terms Prehistory, Archaeology, Ethnology, and History are convenient labels covering various aspects of data from which man's story can be built up. None of them can be regarded as mutually exclusive, and it is only possible to define in general terms the field proper to each.

Prehistory deals with the evidence concerning the material objects left by man at a time before written records or known legendary history. We are concerned with people of simple mode of life, with hunters, fishers, and collectors of wild foods, and eventually with simple cattle-keepers and hoe-culturists; and we have to deal with implements and objects of a simple character, made of durable substances, such as bone, stone, ivory, and pottery, that are capable of surviving to our own time. We can augment our knowledge and place it in proper perspective by a study of the climate, fauna and flora, contemporary with early man, and by our studies of the way of life of existing and analogous peoples living under similar conditions, but we can never hope to reconstruct a complete picture.

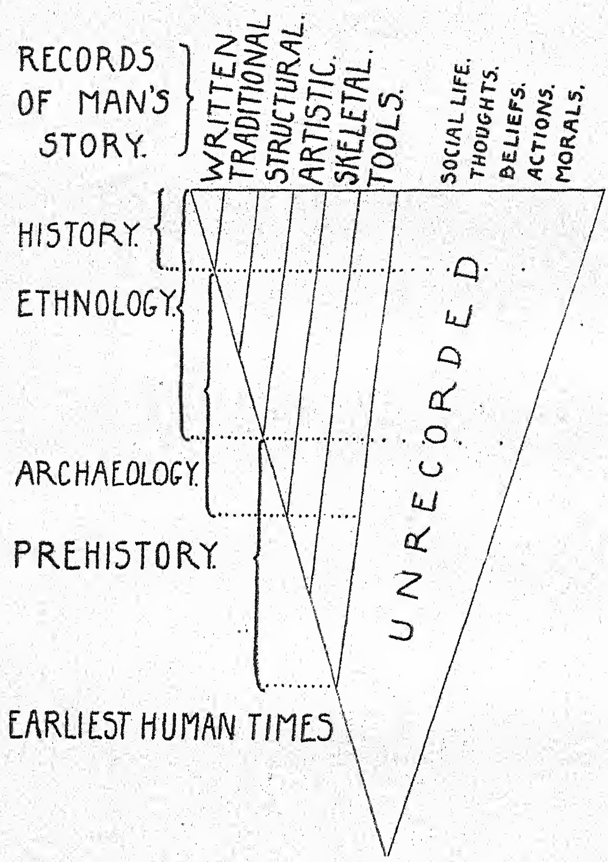

Fig. I.
The records of man in relation to the various conventional approaches.

Archaeology is generally used in an inclusive sense to cover both Prehistory and Antiquity. By Antiquity is generally meant the evidences that clarify or augment written or legendary records of more advanced peoples. Archaeology is often applied to the study of stabilised house, village, and town sites, with some analogy to our own system of civilisation, and it may contrast with Prehistory, which deals with the more rudimentary and less stable homes of early and simple people.

Ethnology and *Ethnography* may be discussed together, as there is little agreement as to the limits of either. They draw

their data from the material objects, history, and traditions of existing people who have no written records of their own. The story of these peoples is written from the outside by visiting, more sophisticated observers, and depends upon a more or less exact observation of objects and ideas prevalent among a people foreign to the observer. The approach is partly comparative, partly historical, and partly ecological. Ethnology is sometimes used to cover comparative and analytical studies of peoples, and Ethnography for the descriptive study of a particular people.

History concerns itself with written records, or with the deduced records relating to such things as the development of institutions, inventions, governmental and economic systems and social usage among a particular people. These are generally related to climate, geography, territorial organisation and outside contacts, in so far as each provides a clue to development and change through any period. The records of History are written by the people themselves, though it is to be remembered that it is the privileged product of a small minority of educated people, living in incomplete contact with the mass of less educated folk that forms the populace.

We can discard from Prehistory in its purest sense those people of whom we have historical and archaeological knowledge, such as the Gallic, Germanic, or British tribes described by early Roman or Celtic writers. In addition we might exclude the study of stone-age peoples, such as the Bushmen and Australian Aborigines, as they might be adequately covered by the ethnographer. They provide us with an important borderline group, and should yield comparisons valuable in the study of earlier man. Work of this comparative type has been done by Sollas, while Daryll Forde has provided a most useful sourcebook for comparative work that might well be read by every man with a bent for archaeology. This latter volume I would regard as fundamental to the study of prehistoric man, especially Forde's earlier chapters.

There are several words that have, in the course of time, achieved a certain synonymity in popular speech and writing. We must define these and discuss them in the more restricted sense we shall be evoking from each. A scientist cannot make

a word mean what he wants it to mean. He must limit meanings to those understood by other scientists, and we are dealing here with those more confined meanings that are accepted by all anthropologists as a basis for intelligibility.

Race: The aggregation of hereditary, non-pathological physical characteristics which every man acquires by the fact of birth, a purely zoological grouping.

A race is a group of people sharing a number of such characters. The number selected depends upon agreement between physical anthropologists, and will be in direct proportion to the number of races recognised. If a number of different characters are sought and observed, a number of races will result; if a few, then the number of races will be reduced. To avoid the political sense of the term, many anthropologists prefer the more cumbersome phrase "physical type".

Culture in its restricted sense means everything acquired by man after birth, a product of nurture within a society, a purely sociological grouping. Tylor for instance has defined culture as "that complex whole which includes knowledge, belief, arts, morals, law, customs, and any other capabilities and habits acquired by man as a member of society".

A culture consists of a group of objects, techniques, ideas, words and beliefs normally associated together at a single time and in a single area. These constitute the definable elements of culture. They are not necessarily associable with any one race; in fact, as more and more evidence becomes available, the concepts of "pure" races and "pure" cultures tend to disappear more and more into the realms of idealistic mythology. To the prehistorian each such culture presents as closely as possible the pattern of typical tools, artefacts, paintings and engravings used by a single people at a particular period and in their own area. These more limited cultural patterns are studied in relation to chronology and geographical distribution by methods that we shall discuss as we go along. The term *industry* is generally more localised in its use, and refers most specifically to the stone, bone, and other implements of man.

Such things as language and religion are both essentially cultural groupings. The English-speaking peoples include a variety of physical stocks situated in the corners of the earth. They include American Whites and Negroes and Indians; Englishmen, Liberians, and a hundred other racial groups. The term Afrikaans-speaking peoples covers a number of European stocks similar in origins to the English. and some addition of Hottentots, Bushmen, Negroes, Malayans and other peoples, in this case confined almost entirely to one sub-continent. There is no Afrikaans Race or English Race. Similarly, the American Negro, who knows no other cultural outlook, language, religion, political system or mode of dress than that of America, is still racially of Sudanic or Bantu Negro origin. In just the same way the Afrikaans-speaking Hottentot is racially of Hottentot physical type, and no different in this respect from his Hottentot-speaking relatives.

It becomes necessary to employ other terms in place of the popular conceptions of race and culture. "People, Folk, Tribe, Nation" will generally cover groups in which there is no great element of homogeneity present.

People: A major group, sharing at least one general characteristic: race, language or religion, or some combination of these. They may or may not be related to a single area. e.g., Mongolian people, Germanic people, Islamic people, etc.

Folk: Usually a subdivision of a people, bound together by strong traditional ties, a cultural continuity, sometimes associable with some general area. Yorkshire folk, Afrikaans folk, etc.

Nation: A group of people under one government, or one federated system of governments, acknowledging a general unity of area, loyalties and interests, and following the same system of law. There is no essential homogeneity of language, race, religion, or culture. The British nation, the Zulu nation, the Russian nation.

Tribe: A group under one government with one language and one system of laws, inhabiting a recognised territory. The members acknowledge a distinct unity, usually based upon common origin and therefore upon relationship in the widest sense of the term. Pondo tribe, Kgatla tribe.

The Evidences of Prehistory

Our programme may sound ambitious, but we can analyse it into its essentials and devise legitimate approaches. We can tabulate the sort of evidence we are seeking. Fundamentally we are seeking to discover the relationship of three main patterns of evidence to one another and to evolving man. Our methods in dealing with the evidence include the use of the most effective means of getting accurate documentation with the least possible destruction. This includes the recording of our original material by means of plans and sections, and the making of written and photographic records of the circumstances of their discovery. But most essential is the preservation of as many as possible of the objects themselves. As in all natural sciences, prehistory consists of the observation of facts and the drawing of legitimate deduction from them, and the collection of material illustrating the facts. It is the evidence we want, not a vague personal aggrandisement through the accumulation of objects that we have rendered useless by our failure to collect records.

ASSOCIATION

i. The various objects associable together to yield cultural groups or cultures.

ii. The distribution of such cultures in relation to their environment.

iii. The physical types of man associable with each culture.

CHRONOLOGY

i. The historical sequence of cultures and human types we have been able to isolate and recognise: order.

ii. The relationship discernible between this sequence and other more general sequences provided by natural phenomena, climatic or geological episodes, the evidence of river terraces, glacial deposits, raised beaches, earth movements, and so on: dating.

iii. The persistence of a single element or a whole culture, either alone or overlapping other cultures, as a relic of what may in other fields have belonged to somewhat different periods.

CLIMATOLOGY

The study of past conditions of local climate, and the story of climatic change. We make use of three sources of evidence, and can eventually link these together to form some picture of environment as it is related to man. This is the study of ecology, the study of man as an active element in his own environment.

a. Types of deposit encountered: desertic sands, mould, loess, aeolian or windborne deposits, and so on.
b. The study of fauna and its analysis into desertic, warmth-loving, cold-loving, water-loving, etc., types.
c. The study of flora, generally confined to pollen analysis, though sometimes including a few mineralised forms.

The prehistorian cannot hope to depend on his own knowledge to cover this field. He must appeal whenever he can to the appropriate expert. When we deal with the more recent periods, this should be less necessary, as climate and environment have not changed greatly, but for more distant periods other sciences have to be called to our aid. Environment and ecology become the field linking archaeology with zoology, botany and geology. In return, we should be able to supply those fields with new evidences, for example, by giving them a cultural sequence that can be employed in a particular area to date deposits, just as fossil evidence is used.

Whatever evidence we can bring to bear upon man's past, and whatever science will yield us proofs and help us to make legitimate deductions, should be fully employed. Ethnological parallels, the evolution and the habits of animals related to those found in prehistoric deposits, the analysis of specimens of soil, the careful recognition and interpretation of geological stratigraphy, the appropriate use of statistics, and any other approaches that we can make serve our ends, will all help to illuminate what is necessarily a very dim field as seen by us to-day. Blind, stupid collecting is sheer destruction of evidence. It is the facts behind the specimens that we want.

A list of books, by no means exhaustive, on the various subjects dealt with in these notes, will be given at the end of this volume. While many of these may be unobtainable in country libraries,

it is often possible to get much of the information there by reading other books on the same subjects, or by turning to the appropriate articles in a good encyclopaedia, such as the Britannica, Everyman's, etc. A doctor or dentist will often have excellent books on skeletal anatomy, or on the comparative study of animal teeth, and it is often worth while to specialise on a particular branch of study, and build up sketch books with careful notes covering all the local animal types, especially the teeth, horn-cores, skulls, etc. Perhaps in time it may prove possible to publish a series of handbooks which will yield "snap identifications" of the genera usual in South Africa. This would include mammals, land molluscs, fish skulls and teeth, and the common sea-shells of both our east and west coasts; enough to add a new interest to the more puzzling objects that we so constantly find here.

III.

MATERIALS AND RECORDS

All broken implements of a ruined house.
Tim. of Ath. IV. ii.

Owing to differences in the permanence of the materials used by prehistoric man, we know less and less of his story as time goes back. Analogies between existing peoples and early man become less and less exact. In addition many of the more durable materials, such as pottery and certain metals, only appear late in history.

The relative permanence of our "documents" can be given a general order, but it must be remembered that the varying circumstances in which they are found and the different chemical and mechanical changes they have encountered, will have profound effects on their durability. In general order of survival, we can list them as follows: 1. Stone; 2. Teeth and cooked bone; 3. Glass, pottery, bronze, gold; 4. Ivory and uncooked bone; 5. Iron; 6. Wood and reed; 7. Skin and other animal tissue. (see Clark, under A in Bibliography).

The cooking of bone, encased in its covering of meat, seems to set certain organic substances in the bone, in much the same way that an egg will set. Cooked bone seems to be difficult to destroy. The complete destruction of bacteria in the bone by heat is probably of value as well. Fossilised material will last as long as a stone of similar structure and composition. Here the object has been made into a permanent record by the substitution, for organic matter, of inorganic matter from the contents of the surrounding soil. Its existence therefore depends ultimately upon the make-up of the soil. Lime is the most useful natural agent here. This process is best called mineralisation, and it may affect wood, bone, or other organic material to a varying degree.

The nature, especially the humidity of soils, affects preservation considerably, and desert sands have been known to mummify by natural desiccation, actually preserving the dried-out tissues almost intact. Consistently dry conditions in a cave may similarly retard deterioration from organic attack. Certain peats will preserve iron objects, others will destroy them. The presence of trees and vegetation will destroy bone and certain types of stone by creating various humous acids which break down the material and so enable the plant to feed on the essential salts.

Some of the most important causes of destruction are the ravages of water, wind, sandblast, earth pressures and a hundred subtle chemical and organic processes. These are factors that are constantly at work, changing the structure of all that we see about us. An idea of their importance can be obtained from Geikie's *Earth Sculpture* and from more recent books on Geomorphology. As a result of these destructive forces we have only the evidence of the stone implements of earlier phases of prehistory, and even these have generally been damaged by wind, water and oxidation, or crushed, affected by fire and frost, and damaged in a number of ways by exposure to naturally destructive agencies. In Europe and countries where ice and snow have played a part, glacial pressure and striation, the crushing action of slipped frozen earth, glacial movements and so on, can be added to this list of destructive forces.

As we come up the scale of time we begin to get some idea of the animal foods used by prehistoric man, and some view of man himself. Cooked bones survive, while animal teeth provide us with a clue to the sources of man's local food supplies at each period. The very uncertain chances of mineralisation may even give us a view of man himself in rare instances. It is only in the most recent periods that animal or vegetable tissues survive, though here and there we may get signs of an impression of basketry in clay, on pottery, or even eaten into ostrich eggshell fragments.

The excavation, interpretation and preservation of these records is the legitimate field of the prehistorian, including deductions made from whatever circumstances surround the discovery of objects in their original setting.

THE RECORDS

Prehistoric deposits

Little attempt has so far been made in South Africa to analyse and study the actual soil of prehistoric deposits. It is in fact difficult to know what type of evidence can be sought. Cave soil must generally be regarded as a whole, even if it is not homogeneous. Ash, and a great variety of other soluble salts can be carried deep into underlying layers in solution, and in the event of considerable exposure to sunlight, might even be drawn up to the surface and recrystallised there. Lime from surface middens may be carried some depth into the soil, and in the more exposed southern parts of the Oakhurst shelter, the lime had consolidated to form an almost impermeable rock below the level at which it might have been expected. The same thing occurs in Peers B/102, a shelter above Kalk Bay.

Various types of evidence may yet be obtained, and, while the soil analysis undertaken for the Mossel Bay cave was of no conclusive value, analyses of other sorts may prove useful. Much still remains to be done concerning the floral background of prehistoric man. Africa is generally a land of mixed forests, and little can be learnt from pollen-analysis here. This method may eventually be made to yield evidence of the general balance of vegetation present locally at a given period, sour veld, sweet veld, open bush, forest, and so on. The fact that a single series of analyses from one cave yields little does not mean much. Analyses from a dozen caves might be found to show valuable evidence.

In some cave deposits implements sealed geologically by later overlaying strata will probably yield a clue to climatic history, and much might be done in such a case by a careful use of soil analysis. The prehistorian should also be able to give the general dating of certain exposed soils containing implement types, and should therefore be in a position to give the soil-analyst evidence as to the time needed for certain chemical changes to take place in the maturing of our soils. This application of our evidence has so far been overlooked in South Africa.

Fire

So far as we know, man has been able to make and control fire throughout the whole of his history. This does not mean that where there is fire there is necessarily evidence of man. Bush-fires started by lightning, organic heat, volcanic action, the friction of dried branches or other natural causes, will yield widespread evidences. It is this wideness of spread that marks the difference between the natural fire and the controlled hearth of man. At the Oakhurst shelter, and later at a sight a mile away, a forest fire was easily recognisable in the deposits, and showed very distinct types of ash and débris. The white hearth ash was typically discernible at every level, but at one level in each shelter there was evidence of a general conflagration, hot enough to burn the old surface midden material and leave typical buff-coloured ash over the whole floor.

In excavating the site occupied near Peking by Sinanthropus, an early ape-like man, remains of controlled fire were found: fragments of chipped quartz brought to the cave from a distance, and pieces of animal bone, both bore distinct signs of burning. From that immensely distant period to the present day man never seems to have lost his power over fire. Isolated patches of ash-heap, reddened limestone, buff-coloured ash from sea-shells, and fragments of charcoal, will all supply evidence of hearths, as will cooked or calcined bone. It is the isolation or localisation of the hearth that is important. That is proof of a true hearth, controlled and maintained by man.

Implements and Instruments

From the technological point of view it is necessary to differentiate between two classes of tools. We may class as implements tools that were shaped for a specific or general use by means of an habitual technique, while we may class as instruments those tools that have been shaped by their mode of use, e.g. borers, grindstones, sharpening stones and suchlike. The difference may be only of technological importance, but it must be remembered that man has always selected stones for their appropriateness to a task, and has used these without further shaping. An anvil may be pitted in use, but we cannot speak of this as an "anvil

technique". In a few instances I have seen grinders that superficially resemble polished axes, having two intersecting polished faces, but it hardly seems right to pre-date the use of polished axes on the grounds that "it must have been used as an axe; it has such an obvious edge".

In any study of artefacts* we can hope to draw various sorts of evidence. We can gauge the standards of perfection that early man set himself. We can estimate his knowledge of his materials, and deduce something of the mode of life of the makers. We can follow technical themes through man's story and watch the constant interweaving of new cultural patterns. We can use the survey approach and plot the distribution of cultural groups, and so make further deductions. We may study the time-relationship between different sites, and deduce migrational routes and spreads from common centres. Each study has its disciplines, which need watching, as deduction carried further than facts allow becomes speculation.

We may sometimes infer the uses to which tools were put by analogy with simple living peoples, or by the constant association of one tool with another, for instance the upper and the lower grindstones. In a more negative way we can deduce the purposes for which a stone could not have been used. Thus the *coup-de-poing* was useless to the hunter: it was heavy and would have needed too close an approach to the hunted quarry to have been effective. It was probably a digging tool.

The whole assemblage of tools of a single culture gives us an insight into the distinctive characteristics of the people. We can often observe cultural contacts, and at times we can see development through a series of phases. This last is most applicable in the fields of primitive art and pottery-making.

Bone

Bone implements appear late, but bone instruments often occur in relatively early deposits, and are often overlooked. In the Moustierian deposits of Europe, the heavier bones of large animals and the tougher small bones, such as the astragalus, are often

* Artefact, artifact. From *arte factus*, made by art. The second form is an assimilation to artificial, from *artificialis*. Both spellings are acceptable, the first is pedantically the more correct.

found to have been used as "anvils" upon which stone implements have been chipped. They bear marked signs of usage and are not shaped in any way.

In later periods in Europe true conventionalised implements occur, and reach great heights of craftsmanship in the Magdalenian period. From these we can deduce something of the way that wood was worked, as there are decided elements of a wood-working technique in the scraping, trimming, and polishing of the bone. This question of technique is important, as it seems certain that the methods used on bone eventually gave rise to the polishing and grinding of stone tools in the Neolithic period.

In South Africa the poisoned Bushman arrow is very generally made of a finely-pointed bone, rubbed down in a grooved stone to the correct shape. Bone awls occur, and so on. At certain sites along the south coast there developed a bone industry that equalled the Magdalenian in the number of specimens, but not in the beauty or in the variety of forms.

Pottery

This is generally late, though evidence from Kenya strongly suggests that there it was earlier than would have been supposed from its dating in North Africa and Europe. Our Bushmen to-day prefer gourds, calabashes and ostrich-eggshells, which are easily replaceable from the local environment. The eggshells are often found in *caches* and in some cases are sealed with beeswax or gum to keep the enclosed water from evaporating. Most hunting people prefer grilled or roast meats to stewed or boiled, or they dry their meat into pemmican or biltong. The nomadic mode of life makes pottery too expensive a luxury, and it is often replaced in other parts of the world by coconuts, skins, bamboo tubes, or even (in British Columbia) by wooden boxes. There is thus no reason to presume that where pottery is not found it was unknown to the natives. Other materials may have been deliberately preferred. There is, too, the question of availability of clay: on coral islands history has shown that the art of pot-making may have been lost by people changing from a clay-producing island to a coral atoll.

The study of the essential forms of pottery may similarly be misleading. The likeness of South African prehistoric pottery to pre-dynastic Egyptian types is mainly due to partial identity of cultural origin, and the tradition has been largely maintained because of the fact that a pointed base is suitable for pressing into soft wood-ash, while both south and north African types are adapted to carrying with rope handles. These two very typical elements gave the pottery its survival value. On the other hand, shapes shared by the Congo and Peru are not likely to have been the products of a single cultural spread.

Pottery is permitted to a relatively stable sedentary life, and (in the case of the Hottentots) by the use of cattle as sumpter animals capable of transporting fragile heavy material. It depends for its form largely on function. Among hunters the pot introduces new difficulties. In the making of pots, long periods are needed for drying, firing, and cooling. In addition, completed pots are too easily broken in carrying from one waterhole to another.

Ceramics and Beads

Now and then in more recent deposits, especially those left by our Bantu-speaking peoples, beads and ceramics of a much more advanced type are found. These should be very carefully kept and submitted to an expert for exact identification. The date of origin of most beads and china can be ascertained within a quarter of a century. This means that a limiting date is given to the deposit. It limits the date only in one direction, as a bead or a china object may be handed down in a stable community for many generations as an heirloom, and may find its way into a deposit only centuries later.

A superficial identificaion is seldom sufficient, and spectroscopic analysis should be obtained if possible. Every type of bead that once had a sales value has been imitated by some rival country, and Birmingham, Venice, and India, have been turning out beads for many centuries in imitation of Roman types, and of each other's best work. If a "type series" of beads is being built up, it is absolutely essential to ascertain that each bead is what it purports to be, and not an imitation. Finally, many tribes have

learnt the trick of melting glass and making beads from the material of old necklaces. This makes the question even more difficult, though the old forms are seldom efficiently copied in the newly molten materials. All these points have to be remembered in attempting to date deposits by beads.

Burial

Careful interment, associated with the burial of a man's most intimate possessions would seem to suggest some belief in an afterlife. Probably such a belief has always been present in man, even if only as a tacit presumption. It is very much easier to believe in an afterlife than to imagine complete extinction with death. The state of complete nullity cannot reasonably be contemplated by the mind of man.

Burial rites are hide-bound by custom, and from the pattern of these rites, as seen in the position and orientation of the body, the association of weapons, implements, pottery, provisions and in the painting and adornment of the body, we can deduce the distribution of a single cultural group. This study of distribution gives us an additional clue to the unity of belief and custom shared by a single people within a geographical area.

Deduction must be guarded. As amongst ourselves, primitive people bury their dead in the conventional sleeping position. Among peoples with no knowledge of weaving, who sleep under a single large animal-skin, the knees are generally brought up to the chin and the hands are disposed by being clasped above the knees or placed under the head. This is the flexed position. Where people habitually sleep in the extended position, beneath woven materials or under skins sewn together, this position is relaxed, though the fully-extended position of burial seems only to occur when the use of a bed is usual. There is therefore no reason to presume that flexed burial is "embryonic" or in a "pre-natal" position.

It is the custom among primitive people to paint or dress up especially sacred persons in some ceremonial colour. Among ourselves wode was once employed, but to-day white is used to denote the sacred person in a christening, confirmation, marriage or burial. Among our southern Bantu white is generally used for a young ini-

tiate but red ochre may be used for other ceremonies. Burial is the only ceremony in which we sometimes have proof of early man's use of paint, and red ochre is one of the few paints that survive long periods of contact with the earth and flesh, and it is the easiest of the earth colours to obtain. Therefore there seems little reason to build up a theory that red ochre represents the "life-giving element in blood", and that it was applied with a view to reviving the dead. Man has always had a horror of the living-dead, the *révenant* or the *zombi*. Burial seems to have been designed to dispose of a dead friend who has achieved a new and terrifying state of existence, and not to bring him back to the abnormal state of living death among the tribe. Even the most primitive men, with the simplest types of mind that our city scientists can create for them, could hardly be likely to perpetuate the consistently unsuccessful experiment of trying to revive the dead by painting them red on the outside, in order to revivify the red corpuscles inside. The painting of a body is to be regarded only as a means of marking it off as having achieved an especially sacred state. The use of white or red is really immaterial, and is primarily of interest in showing the distribution of particular cultural habits.

The orientation of the body, to face east or west, etc., may often be misinterpreted. East is the position of the rising sun, and the Christian orientation is related to the expectation of a joyful resurrection. Among many people orientation is known to be towards a legendary home or origin. It is only our knowledge of present-day Islam that teaches us that the dead Mohammedan faces Mecca. Had that religion died wihout trace, we would never have guessed that graves in Albania, Arabia, Mauretania, India, South Africa, China and Southern Russia were all orientated relative to a central city. At Oakhurst, of the skeletons of which the orientation could still be recognised, 6 faced west, 5 faced east, 3 faced south-west, 2 south, and 2 south-east. All that can be said is that none faced north, — the mid-day sun.

In interpreting the customs of simple peoples, the presumption should always be that origins of customs were rational in the first place, the obvious outcome of cause and effect as seen by primitive man; and that they became irrational only as a result of the natural attempt to explain them "rationally" in the

light of primitive man's incomplete knowledge of the real factors involved.

We know that among simple people to-day a man's personalia, or most intimate possessions, are buried with him, largely to break down morbid sentimentality among the survivors, not necessarily because of any belief in the afterlife. Among others this custom links itself with a distinct belief in an afterlife, and among many of our own Bantu, seeds of all foods are buried with a chief or headman, and he is asked to intercede for fertility and rain. In the same way, in some burials the quantity of animal bones found may be the results of the normal accumulations from feeding; in others they are only to be interpreted as the remains of a "wake" or a funeral feast. In yet other cases they may be a holocaust associated with the burial of a powerful chief, such as occurred in Ashanti up to recent times. In Moravia a Proto-Solutrean burial of twenty persons was lined with mammoth bones, suggesting some similar belief. This all suggests that funeral cults were early. We often find a careful arrangement of personalia. The more important the person, the more important his funerary rites; and in general, the more complex the rites, the more complex was the social system that gave rise to them.

Gravestones among existing peoples may be memorial, but they are quite as often used to protect the dead against depradations of wild beasts, — the wolf still exists in much of Europe. In some instances stones are said to be used to prevent the return of the dead to the haunts of the living, where they would intrude horribly into a social life which they can no longer reasonably fit. It is very likely that the same varying reasons existed among prehistoric peoples. There can be no general formula of explanation.

We might here note the futility of pyramiding motives on to known data concerning prehistoric man. Certain deductions can be made from our knowledge of existing peoples; these may be negative, showing that certain things do not occur as beliefs to-day, and so probably did not occur to early man; they may be suggestive, showing that similar customs arose to fulfil a variety of differing needs among various people; or in a very few cases they may be conclusive, showing that they form part and parcel of a general system of ideas and beliefs consistently present in

the genus *Homo*. Into these last categories we can place religion and belief in the afterlife, in the broadest senses that these words can possibly connote, and the habitual association of death with sleep.

Even outside our own species, beliefs of like nature may exist. Breuil has suggested to me the possibility that the almost consistent finding of Neanderthal skulls completely dissociated from any other bones, may be the results of a skull-cult, recalling the widely divergent cults of Sarawak and the Andaman Islands. (These may be studied in Haddon's *Head-hunters, Black, White, and Brown,* which can be obtained in a cheap edition published by Watts.)

Questions of stratigraphy, methods of excavation, and the associability of grave contents, will all be dealt with under the excavation of a cave site (chap. IX.) What will be said there should apply to the excavation of graves in the open air, though there the somewhat difficult question of stratigraphy does not arise so strongly.

Art

Prehistoric art can be divided generally into parietal or cave art, and *art mobilier* corresponding to applied art or handicraft. Both have a somewhat mixed origin, and both are in part related and each has its own very considerable interests. To the artist and critic, the origins of art are important. In its beginnings art implies the expression of certain desires, and is founded upon wish-fulfilment. To-day such interests have been so overlaid and disguised by display, professionalism and the habitual exercise of an acquired set of techniques, that it is of some interest to try to discover how artistic expression began. Art probably expressed man's most insistent need, and it is obvious that this to the hunter was for fresh meat. The delineation of food animals was the dominant theme; in Europe the horse, buffalo, pig, deer, etc., far outweigh the few lions, bears, foxes, wolves, and other carnivores. The same is true of later African art.

From simple wish-fulfilment may have grown further, more complicated causes of artistry. Possibly the much overworked "sympathetic magic" may have entered into the story as an early "rationalisation" of art: the desire to gain some spiritual control over animals by defining them. A variety of other rational

elements would weave themselves about art, such as the practice of habitual and enjoyable skill by recognised artists, superior and specialised persons with recognisable abilities. It should be fundamental to the study of prehistoric art that a rational explanation should always be preferred to an irrational, religious, or magical one. Speculations on origins are the realm of the philosopher and critic, and are habitually twisted to conform to any theory that may hold the public eye at a particular moment. In truth we know very little about the magical, social, or religious expression of prehistoric man.

To the prehistorian the study of early art is a search for the measurable or identifiable qualities: the sources of pigment; the manner of preparation and application; the choice of subject; whether animal, vegetable or human; the arrangement of the content: whether men or animals are drawn singly or in groups, whether they are static or in action, whether they are palpably alive, dead or at rest, or are taking part in some scene; what ornaments, buildings, and implements of everyday life can be identified with certainty.

The style of art is a study in itself, and "schools of art", as distinct as those that occur in our own world, are recognisable and can be plotted as distributive elements. Quite apart from the bald division into petroglyphs and paintings made in the distribution map published by the Archaeological Survey of South Africa, questions of style and technique are important. Content, and even certain elements of style, are shared by both paintings and engravings, proving that there can be no question of complete divorce between these two forms of art.

Many questions in South African art are unanswered, and must remain so until concerted and planned effort analyses vast quantities of evidence. This would have to be undertaken as a true survey, by trained workers, neither artists nor prehistorians, but a reasonable combination of both, persons capable of accurate copying and observation, with the additional ability to take careful scientific samples from the three or four inches of deposit that usually occur below paintings or about engravings. The work needs direction, and in our sub-continent could be undertaken only by careful co-operation between local workers of the trained amateur type.

How is it for instance that at Camp Siding and at various other sites we have a painting of a native offering an eland three leaves? Was this an early attempt at domestication; was it a widespread custom or legend? The common repetition of such elements as the woman's apron, the "devil" (certainly a man dressed for the Dance of the Eland Bull*) in both paintings and petroglyphs, proves that these two channels of expression were at times culturally related as is shown by the association of paintings and petroglyphs at various sites. In contrast the apparent confinement of footprints and flower-forms to petroglyphs, balanced against the habitual groupings of figures in most styles of paintings, shows that these modes were in part separate. The odd manner in which a rhinoceros has been converted into a "mammoth" in the Transvaal, while zebras and quaggas, pecked in identical style, have been similarly treated as far south as Vosburg, certainly means a close connection between these two areas.

We shall deal with methods of copying and reproduction and of preservation as these subjects arise under their proper chapters.

* See Miss D. F. Bleek. The Naron. (University of Cape Town.)

IV.

THE INTERPRETATION OF EVIDENCES.

A crown's worth of good interpretation.
II. *Hen.* IV. II. ii.

Some knowledge of other sciences is essential for a complete interpretation of the materials of prehistory. It should be enough to give the student a thorough appreciation of the methods, the disciplines and the permissibility of evidence in various fields. What is perhaps more important, it should lead him to the appropriate works of reference, and to the right type of expert, so that he can take the fullest advantage of what is known on particular aspects of each subject, and be able to fit it into the framework of purely archaeological data. Archaeology is essentially a survey, and no true survey can be undertaken without the collation of evidence.

The interpretation of human skeletal remains

This is a specialist's field, but every prehistorian should be able to recognise those physical types that normally occur in his own area, and in addition understand the fundamental fossil types of classical archaeology. He must know sufficient to treat with special care and perception those human remains likely to yield important new evidence. If a skull of possible importance is recognised *in situ,* either because of its general conformation, or because of the stratum in which it is found, or the associations found in the grave, it is very necessary to obtain the help of witnesses who are competent to testify as to the archaeological age of the skeleton. If possible, a trained geologist and a physical anthropologist should be invited, and an expert photographer, either amateur or professional. If this means leaving the site unguarded for a few days before the extraction of the bones can be completed, all publicity whatsoever should be avoided, and the local magistrate should be contacted and asked to arrange for

some sort of guard or surveillance of the site. Samples of surrounding soils, both over- and underlying, should be taken before witnesses, and if possible the entire grave, soil and bones, should be removed for careful laboratory excavation. (See under Preservation.) It is however ridiculous to take all these careful precautions, which may prove tedious and expensive, in the case of a simple interment belonging to the Later Stone Age and of a normal physical type.

Adequate text-books have been written by two South Africans, Stibbe and Drennan, and each has a very different approach to the same subject. These need a good skeletal chart or an actual subject on which to make preliminary studies. Many doctors have skeletons from their student days, and many have studied physical anthropology. Following a study of these books, one should obtain Keith's and Boule's works of reference, but some knowledge of basic terminology is needed first. The *New Light on the Antiquity of Man* volume by Sir Arthur Keith contains much of the South African material. Within the Union there are various papers by such writers as Dart, Drennan, Galloway, Broom, Dreyer, Wells, Gear, etc., that will elucidate the problems of South Africa in greater detail. Leakey's work on the prehistoric types of Kenya Colony supplies excellent descriptions and illustrations of remains from his own area.

The study of our own species is mainly concerned with racial differences of a minor order, but the study of Neanderthal, Rhodesian, Florisbad, Boskop and other types of fossil man, often concerns itself with an evaluation of the abilities, aptitudes, and physical habits of the species concerned. Skull capacity and the convolutions of the brain become important; the relation of the limb bones, the curvature of the spine, the distribution and relative strength of muscular attachments, all have their uses in this study. They supply us with the musculature and mental capacity of the species, and provide important comparative data.

The skull contains the brain and the teeth, and is therefore of the greatest importance. Evolution is directly related to the increase and disposition of brain capacity, the intricacy of the convolutions of the brain, and the recession of the lip line in relation to the face as a whole. This is often associable with changes in the prominence of the eyebrow ridges, and with certain

important variations in the musculature of the jaw and the base of the skull, again related to the fundamental balance of the skull, the curvature of the spine, and the whole stance of prehistoric man. These supply the field of the comparative anatomist. The paramount importance of the skull should never be permitted to make the excavator careless about retrieving the limb-bones. These are essential parts of man's anatomy, and have their own story to tell. The entire skeleton, together with its implements and other associations, must be collected and studied as a single whole.

Our task virtually ceases with the taking of simple essential measurements *in situ,* the photographing of the skeleton in the grave, the careful recognition of the stratification at the mouth of the grave to determine the correct cultural associations at that point. Finally the expert opinion of the physical anthropologist will be added to that of the excavator, and as complete a picture obtained as is possible. We should be able to reconstruct every item of real evidence, and even the essentials of the grave itself from our records. This will be dealt with in greater detail when we discuss excavation.

Palaeontological evidence

The student should have a working knowedge of the animal types of his own territory. In the study of a mixed fauna, so typical of Africa, teeth yield the most important evidence. Zoologists make use of the teeth to define specific differences, though in the case of antelopes, where the differences lie largely in the size of the animal, the evidence of the horn cores and long bones is of value. Identification by teeth has the advantage that the same animal remains are not so likely to be differently diagnosed from different elements of evidence.

As teeth fall into several general groups, the task is not very difficult, and any zoological work that includes material on comparative dentistry (odontology) will supply the necessary data. Many local dentists have works of this sort. The teeth of the elephant, hippopotamus, hyrax, rhinoceros, pig, horse, buffalo, the antelope, baboon, hare, human, etc., should all be studied, sketched, and remembered.

If midden sites are encountered, the position becomes more complicated. Here the main fish groups have to be studied, and bones, teeth, shells, and even scales, become important. Such types as Donax, Patella, the various mussels, etc., should be known. Tortoises need to be studied, as these are often sent in as human skulls. All that is needed is a note-book with sketches of local types. Oddly enough, few of our museums have a complete series of fish-teeth, skeletons, or even shells. They seem to prefer the preservation of complete specimens in alcohol or plaster; but the jaws and skulls of edible fish can readily be obtained, boiled, labelled, and mounted with Durofix and wire.

It is the totality of the fauna, not the individual example, that fixes the climatic conditions of a particular period. Our knowledge must be built upon the evidence yielded by existing types, and must be somewhat guarded. We know for instance that the elephant to-day prefers the soft light of forests, a warm climate, and relatively flat country, but the prehistoric American and European elephants were seemingly adapted to the glare of light from snow. The Atlas elephant, like the Knysna elephants, seems to have preferred the slopes of wooded hills to flat plains. Perhaps the elephant family is as adaptable as the human, and may be able to exist under widely different conditions. The pig is a bush animal in Africa, while his cousins in Europe live in beech and oak forests. Being omnivorous, the pig is adaptable. These and other families of animals show a very wide adaptability to varying environments, and it is only when we are dealing with animals of identical species that we can presume that the specialisation to climate was the same.

In the case of both sea and land faunas, an inclusive series of identification is essential, enough to cover the whole gamut of species used by man at a single period. Much faunal evidence of this sort has been lost (or even deliberately destroyed,) by our own zoologists who discard the ordinary in favour of new species. When fauna from a limestone cave or deposit is studied, a careful check-list should be made of the variety present, and the proportions of different animal types. Once the list is made, the material may be discarded, and histograms comparable to those developed for pollen-analysis in Europe can be built up. Such

a work would take time, and needs a comprehensive knowledge, but it provides the essential link between the ecologist and the descriptive zoologist. Surely it is the aim of the ecologist to be able to gauge the environment directly from a study of fauna?

Even negative evidence has its value, except in the case of such species as the dog. While this animal does occur in Portuguese midden sites, it would only so occur among a people who ate their dogs when non-carnivors were scarce. If dogs die naturally while hunting, it is hardly likely that the remains will be brought back to the midden. If dogs die in the home they are hardly likely to be permitted to rot there. In general, among primitive peoples the dog is essentially parasitic, a scavenger, and neither a trusted friend nor a domestic pet. References in the Bible show only one companionable dog, that of Tobit in the Apocrypha.

Annual and seasonal migrations of animals may not make themselves apparent. In caves and shelters where people migrated to follow the annual movements of game we may get a distorted view. Seasonal migration certainly affected the Orange River region, to which the Bushmen and Hottentots seem to have migrated to follow the seasonal pasture land, leaving the winter-rainfall area for the summer rainbelt. Here we might get the impression of one people in the winter living on one fauna, and another group living on a different fauna in the summer rainfall area. Our knowledge of habitual migrations as described by Levaillant and a dozen others gives a different picture. It is possible that the presence of mother-of-pearl ornaments and sea-shells may yield clues to this type of movement to inland sites; while the presence of giraffe vertebrae etc. at the coast would yield evidence in the opposite sense.

It is highly probable that the midden deposits at the coast are partly seasonal, inhabited for part of the year by neighbouring inland tribes who became eaters and trappers of fish when the land fauna migrated. Evidence of this will again lie in the identification of coastal elements inland, and the local survey of such cultural elements as painting styles, and so on. The recent example of the fish described from the Ladybrand area, which are very likely to be sea-fish, is of interest here.

Hunting is differential. The products of the hunt do not exactly reflect the full range of animals at the time. It is selective, as people show marked preference for certain meats, which is not entirely governed by rarity; who would eat goat in a sheep country? In addition, the question of the ability of the hunter to kill or entrap certain types of animal must be considered. Elephants are never killed by a single hunter. Among our southern Bantu the method employed was to bait the elephant to chase a hunter uphill. As the heavy beast tired in its mad charge against gravity, other hunters came out and speared it.

In South Africa we can never hope for much evidence of major climatic changes from our fauna types. Conditions have varied in humidity, not in extreme changes in temperature. Thus rainfall has varied, but without glaciation. The disappearance of certain animal types has in most instances been a result of human activity rather than of climate. The quagga has been hunted out of existence, and, like the dodo, is dead. The habit of fencing farms and roads has killed off whole herds of animals unable to escape the rifle, and unable to undertake necessary annual migrations to suitable pastures. Beside the migrationary paths of animals we must expect to find the remains of animals quite unsuited to local conditions. They are in process of passing from one suitable area to another, and have, in all probability, succumbed to adverse local conditions and lack of water.

Botanical evidence

This is an untouched field. Two groups of evidence have been employed elsewhere: the dating of deposits and minor weather changes from a study of certain trees, such as has been found possible in California; and a study of the totality of plants forming the floral background to a period by means of pollen-analysis, such as is used in Europe to-day.

Optimum climatic conditions occurring irregularly will permit the maximum growth of trees, and these conditions record themselves in the annular growth of large forest trees. One tree can thus be dated against another, and the climatic history can be read from the rings of growth. This can be made to link with fossilised trees where these are abundant. In time the study of long-lived trees may yield a story showing the climatic history of an

area. Some attempt might possibly be made to study the annular growth of the cut timbers in some of our older farmhouses, but apart from this our evidence here falls very far short of that of California.

In the study of pollen, the plotting of the totality of plant types should give some idea of local plant ecology over a period, and some work on existing plant associations has already been done by competent botanists. As in the study of fauna, legitimate deduction can only be made from the study of innumerable examples, and we can hope for no real evidence from pollen studies in individual deposits. It is the balance and total of fauna and flora that gives us our complete picture of environment. This is more especially true in Africa where mixed forests are the rule, in contrast to the alternating forest types found in palaearctic regions such as were affected by marked climatic swings from glacial to sub-tropical conditions. In Africa changes in precipitation affected the flora as a whole, and probably only encouraged certain types of tree at the expense of others. But even this may eventually show itself in some way. Changes producing bushveld, grasslands, forests, sourveld, sweetveld, thornveld, karrooveld, etc., should show themselves in pollen.

Geological evidence

The substance, nature and position of a stratum containing or related to prehistoric material can yield a variety of evidence. The substance of the deposit may show past aridity or humidity. The nature of the deposit will show under what conditions of wind and flood it was accumulated. It might show signs of a water-borne or a subaerial origin, or it might be detritus carried down a hillside. Towards the Drakensberg we might find glacial deposits, though these would probably have little value here, as we have no signs of any intensive glacial action anywhere in the Union during the human period.

Our most important evidence comes from the study of the relationship of one deposit to another. This is generally termed stratigraphy, and consists essentially of the recognition of the order of deposition of layers in some vertical plane. Stratigraphy can then be translated into chronology.

A study of the nature and intensity of the forces that created a deposit can be made from its nature, size, and spread. This gives some idea of either the duration or the maximum intensity of the forces that did the work, and the various actions that have taken place since then. Thus a fragment of gravel or waterborne sand left as part of a terrace, will indicate how deeply the river has since cut. It may have cut in a single great flood, or it may have been cut constantly and evenly by a regular flow. The size of the elements composing the gravel may help us here, as will the thickness of the deposit and the nature of the material. These evidences may show that the river was once swifter and larger, or that the flow has been constant and unvarying. From our evidence we can make further deductions as to the history of the particular stream. It may be found that the river drained a greater area at one time, or that precipitation was greater for one period of its history, or perhaps that some natural barrier broke, and allowed accumulated water to burst through and to scour out the river bed.

The dry sands of the Kalahari, forest leaves, humus, slow-moving muddy streams, regular winds, and so on, all yield typical deposits. Fragments of rock carried from one area to another may be made to yield evidence as to their origin, and we can sometimes deduce from the state of the material whether it was waterborne, carried by glacial action, or brought by man himself for use. From evidence of some change in the direction of flow we can learn something of the aspect of the country at the time. Careful study of a large scale map of a river bed, with contour-lines, will sometimes suggest piracy from another stream, or even a complete reorientation of local drainage. This can be made to supply us with evidence explaining the distribution of gravel beds and human implements.

Pluvial evidence

In field research it is essential to refrain from drawing conclusions from data outside one's own field. The frequency with which deductions are made from single gravel deposits to bolster up some new "pluvial theory" is irresponsible and harmful. An entire river basin, including both main and lateral streams, must be studied before such a climatic cataclysm as a "pluvial period"

can be evoked. Dr. du Toit has reminded me that there is a good old word, *flood*, that would quite adequately cover localised phenomena. Caught in an old mine-working in King's Kloof, Krugersdorp, I have seen an hour's heavy rain remove soil from a length of 150 yards, to a depth of six feet, and a width of fifteen feet: roughly a mass of 1500 cubic yards. At the Cape a single rain has been known to deposit a gravel bed fifteen feet thick. These are extreme localised results of single falls of rain of high intensity, possibly not covering more than a square mile of territory, and certainly not to be regarded as "pluvial periods". Spate or flood would far better describe the facts as they are.

The deduction of climates from one area to another is similarly dangerous. Whatever is proved for the summer-rainfall area cannot be applied in the winter-rainfall coastal strip. In fact Commander Gracie has suggested to me that the indications are directly to the contrary.

Ethnological evidence

Under this head might be included two rather distinct types of evidence. There are the interpretations given to individual facts in the light of our knowledge of other existing peoples in a similar stage of culture. Then there is the direct application of ethnological method to masses of material collected from a wide area, and without any necessary reference to existing peoples. We shall deal with this latter head when we speak of Survey Methods (Chap. XIII.)

The most striking example of direct deduction from living peoples was the case of the Magdalenian spear-thrower in Europe. This queer object could never have been understood had not the Australian aborigines made use of an exactly similar propulsor. Very similar deductions are often made regarding post-holes in Europe. If a set of posts were set upright in a circle a few yards across, and if their casts show that each was perhaps three inches in diameter, then we can reconstruct the type of hut that must have existed from our knowledge of other peoples. Much deductive work of this sort has been done on the Swiss lake-dwelling; though when we get to questions of detail, deduction becomes guesswork, and must be most carefully watched. In dealing with such ancient megalithic monuments as Stonehenge,

and the weird prehistoric remains in Brittany, we have direct analogies with existing peoples in further India. The team-work they use to-day must have been very similar to that used three to four thousand years ago in Western Europe.

In South Africa, the amazing similarities that can be seen between the Mossel Bay and Still Bay implements on the one hand, and the tools used by Aborigines in Australia to-day, cannot be ignored. Possibly the time-gap between these two periods is even greater than that covered by the spear-thrower, yet the similarities are so marked that we can reasonably infer that they were mounted and used in much the same way, and that the Australian shows a survival even more persistent than that of our own Bushmen. Our inference is made all the stronger by the presence of Australoid characteristics in the Cape Flats skull, and still persisting in Broom's Korana type of skull. The additional implications of the similarity of physical type augment the evidence, but do not prove that our original deduction was true. It is circumstantial evidence which can only be accepted as adequate when it builds itself into a far more complete and logical picture.

Knowledge of our own Bushmen tribes should give us a number of clues to our Later Stone Age deposits. The typical bone-arrowhead, consisting of a complicated little assemblage of two fragments of bone, the one sharply pointed at one end, and generally poisoned, the other less pointed at both ends, and slightly thicker, have frequently been published elsewhere, and need not delay us; but the consistent finding of similar bone points at great numbers of prehistoric sites shows this form of point had a widespread distribution all through Africa. The evidence of the glass arrowheads, though made to the order of Dr. Bleek during last century, yields us a clear picture of the accepted methods used in mounting microlithic stones. Methods of beadmaking, and so on, have been described and should be made to yield clues to odd fragments found in deposits. The uses of ostrich eggs, bone tubes, awls, tortoise shells, and other material found in cave deposits, will repay a visit to the various museums of South Africa.

This use of analogy with the material culture of existing people is generally automatic, but deserves greater exactitude of interpretation. For instance, in the wild-melon areas of Southwest

Africa, the Bushmen each carry *tsama* or melon knives, leaf-shaped flat blades of bone, about 7 inches long, and bored for suspension towards one end. These are constantly quoted by ethnologists as proof of the wide distribution and spread of the "bull-roarer", a slat of wood very similar in shape, that is swung round on the end of a thong to produce a roaring sound. The simple form is the same, probably an adaptation of a widespread wooden shape, but the function is different.

The pitfalls opened up by form and function are numerous. Different peoples invent very different ways of meeting the same need, the variety of shapes of hut shows this. But conversely, different peoples often invent superficially similar objects in order to satisfy very different needs. We may take it as a rule that the simpler the essential form, the more likely it is that a number of different people have hit upon it, either for the same purpose, or for different purposes. When we get to more complicated forms, the chances of two similar objects having different functions is very remote, and we can make our deductions with greater safety. It is to be remembered constantly that deduction needs a thorough knowledge of both form and function.

V.

NATURAL SOURCES OF ERROR

Make us adore our errors.
Anth. and Cleo. III. xi.

There are a number of possible causes of error in the study of prehistory. They are generally chance products of natural or mechanical action, apparent man-made objects or implements, many of which are constantly appearing in museums or are reported in the press. In some few cases it is a little difficult to be quite sure whether or not they are of human origin, purely natural, or natural objects that have been modified by man. Most geologists can give advice on the probable origin of material that falls within their sphere of knowledge, but unhappily the finder is himself so firmly convinced that he does not seek advice, and, when it is given it is often resented.

Local enthusiasts should make a point of collecting and observing material from their own areas, as each climatic and geological region has its own very peculiar problems, and these make an interesting and instructive study in themselves. A few museums, and all Universities where archaeology is studied have collections of this sort, and are willing to add to the series. I have attempted some simple classification by origins, and give these under various heads.

1. Purely natural forms, products of growth, crystallization, natural castings, etc. This covers odd flint nodules, nodular stones generally, stalactites, stalagmites, fossilized plant and animal forms, natural crystals of iron compounds, gypsum castings of cavities left by decayed wood and animal tissue; the normal growth of bone, wood or horn, especially where these have been affected by wind action or are waterworn. The annular growth of stalactite forms about a natural central pipe, and the palliform growth of the stalagmite without the central passage, are easily recognisable at the point of fracture. Figurines, phalli and even implements can

often be "seen into" these curious forms. This gives rise to the fallacy of accommodation or adaptability: "This must have been an implement — it fits the hand so perfectly".

I have been presented with the spiral growths of forest vines, and with numerous crystalline forms. One series of cubic crystals of an iron salt pyrite constantly recurs, handed in as "prehistoric dice". The main crystal shows a perfect cube, with minor crystals protruding as "markings" on each face. Shales from which softer layers have been leached or eroded are frequent sources of error. In a few cases crystalline or other materials have formed round a wooden core which has subsequently rotted, and the product simulates a bored stone. The little trapdoor (operculum) of Streptoneura (Gastropod) gives the appearance of a carefully rubbed down shell, and examples are often submitted as a sort of kitchen midden coinage. One collector made a great point of collecting many examples of the bony forehead of a large fish: a rounded, elongated symmetrical bone with a descending process that suggested apparent "wear" at one point. He believed that the recurrence of wear at the same point was proof that the bone was used as an implement.

Such forms do not confine themselves to hand-material. Dolerite by reason of its tendency to develop a columnar structure in the sheet, often produces 'palisades' or 'jointed pillars', structures often called ruiniform. These are at times reported as the work of some giant builder, a veritable Valhalla. In parts of Namaqualand and elsewhere, hard intrusions into softer rocks have withstood the ordinary weathering processes, and have left perfect 'walls'. The same sort of process presumably accounts for the "Lost Cities of the Kalahari" that infest our press from time to time.

Certain rocks tend to cleave into cube or diamond forms. If these are subsequently waterworn or windworn they tend to assume very symmetrical forms that suggest human agency. These should be studied carefully to see the relationship of the fine stratification of the rock to the various faces. If the strata are parallel to two faces, the chances are that it is a natural form.

2. Natural forms affected by animal action. The most common are sea-shells bored by predatory molluscs. These are

constantly found on sites, but need not be discarded. Though they are products of animal action, the dead shells have been collected and carried up by man, probably as simple ornaments, and therefore form part of his culture just as much as coral or curious stones.

The gnawing habits of rodents probably account for more errors than anything else. I have seen an excellent "spoon" displayed in one of our museums, manufactured by a porcupine. This beast is an indefatigable faker of evidence, and is a cave-dweller. Tooth-marks can be clearly seen, long strokes mark the lower jaw, and opposite them niches are cut by the upper teeth. Many stones show signs of this action, and even balls of hard clay are to be found in the Cango caves.

3. Mechanical action. Crude flakes are often found with apparent working along an edge. This may be a product of subterranean earth pressures or soil-slip, bringing stones into contact with one another. Rockfalls, the tidal action of the sea, or river flow, may all produce analogous effects. In the case of exposed flakes from the surface, hoofs and boots produce similar effects. Road metal often produces chance flakes, and I have an excellent series collected from half a dozen different roads.

Much has been written on this group of "errors". In every case the deposit and circumstances must be taken into account, with a view to assessing the stresses present. It is necessary to look carefully at each series to discover if any "intention" (technique) can be observed. This needs a long acquaintance with primitive tools. Steep slopes, talus or beach are suspect. Note if the flakes lie directly next to the "cores" from which they came. This is absolute proof of natural action. Similarly, bi-polar flaking, the quartering of pebbles, etc., are suspect.

Now and then wind or water action will produce stones that resemble "Neolithic" axes. These belong to the *"driekanter"* class. A series is shown by L. C. King (fig. 115) from New Zealand.

4. Desiccation. Mainly applicable to shales that have dried out and schisted in contracting. This may occur under pressure from overlying rock.

5. Thermal action. The product of insolation or fire. Blackwelder treats of this, but we can afford to go into the question

in some detail, as grass and bush fires followed by rain, affect much of this continent, and these forms are likely to occur frequently.

In this action, the cooling, and resultant contraction, of the outer part of the rock over the mass of still-heated interior may cause the tensile strength to be exceeded in the outside crust, so that cleavage develops, influenced by lines of weakness. Curved wedges, plates or scales, would peel off to leave a more rounded core of rock. Fire is thus capable of affecting firm standing rock, especially brittle igneous or contact rocks, flints, quartzites and limestones. According to Blackwelder, most igneous rock will stand sudden heating and cooling through a range of more than 200°C. without damage, but will generally fail between 300° and 375°C. Most rocks endure slow heating and cooling up to 600°. This is very evident from the care taken in cooling the 200″ telescope reflector built for America. Blackwelder concludes that insolation (sun-action followed by sudden frost, rain or snow) is insufficient to produce spalling. Much that has been attributed to "insolation" is shown by him to be due to chemical changes, following (most frequently) the addition or loss of moisture in the rock.

Rock-spalling of this type ("The curved spalls of sound, undecayed rock are quite distinctive") are found throughout the dolerite country, where rocks weighing a ton or more, cubes forming part of natural ruiniform structures, are spalled to depths of an inch in positions where fire could hardly have reached them. The spalls, often from the corners or edges of rocks (diaper-shaped and banana-shaped) are constantly submitted to museums, especially from the Victoria West district.

Heat-spalling can often be seen in my Vosburg paper. In plate XLVII the spalls are still *in situ* and may be of a date later than the pecked eland whose horns cross the crack. Another view of the same rock shows that the rock was cleft, probably by lightning, and has since spalled some distance from the point of impact of the lightning stroke, on which Mr. B. D. Malan's hand rests. Plate XLIX shows recent lightning action, long preceded by spalling. The view of High Rock (plate LVIII) shows the general rounding effects of spalling.

Analogous though dissimilar spalling has affected the Rhodesian granites to a fairly constant depth of about three inches. The spalls were used to supply the builders of Zimbabwe with the so-called "trimmed blocks" used by them. Many granites resound in a hollow fashion. We are thus left with the strong probability that large material will respond to insolation where hand-specimens may hold firm. L. C. King (pp. 15-16) gives a different explanation, suggesting that the release from an over-burden may permit the granite to adjust itself after long compression. This may perhaps account for the granites at earth level, but does not sound convincing when applied to high granite boulders well above the level of the land.

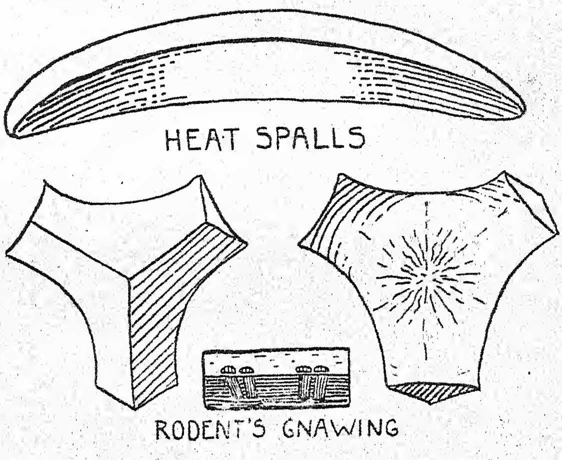

Fig. II.
Causes of error.

It is enough to say that spalls of this peculiar form occur in dolerite areas, typified by a concave cleavage, emanating from the centre of the flake radially, and not from the edge. Lines of force are often visible on convex mass and on concave flake, and superficially resemble the lines of growth on a child's skull. At Oudtshoorn almost every implement found bears the convex scars of this sort of fracture. This is small hand material, and distinctly suggests grass-fires as the cause, though why it should be so localised I do not know.

6. Chemical erosion and staining. While roots and lichens may colour stones, I have only once received photographs of lichen-covered rocks as evidence of an "unknown script" in Southern Rhodesia. Far more misleading are little furrows left on shale that has been in contact with roots. Microscopic examination shows it to be a form of corrosion through humous acids, and there are no signs of mechanical engraving. Natural markings on shales may be a product of impressions from underlying material, present at the time of deposition. There is an excellent "Mosaic pavement" in a cave fifty feet from the Cape St. Blaize cave, Mossel Bay. It forms the ceiling, and results from the contact of the steeply dipping T.M. Sandstone and the overlying Enon conglomerate. The T.M.S. has subsequently eroded to leave the Mosaics.

The appearance of circular markings on river pebbles is in the first instance due to the impact of stone against stone, but they often permit staining by a local accumulation of iron oxides, suggesting an etched surface with colouring matter added.

Under certain conditions bone may be tinted a bright blue or green, suggesting the presence of copper salts. It is more likely to be due to the formation of ferrous phosphate of iron, from the contact with surrounding soils of suitable make-up.

7. Polish. In arid countries, typically at the Victoria Falls, highly polished or glazed stones occur. This is a silica varnish, proper to certain desertic conditions. A superficially similar glaze is often to be seen on rocky ledges in caves. This is an animal varnish, the crystallised remains of Hyrax urine. Surrounding deposits are coloured a deep yellow, often with masses of crystalline urine in pockets. At the same time the ledges are smoothed and rounded by the constant running about of the Hyrax (dassie).

8. Natural Cleavage. Various slates, shales and similar schistose rocks tend to cleave into regular forms, many of which are purely crystalline, and their origin may be disguised by subsequent water or wind action. I have an excellent example of a flint-like chalcedonic rock that has been polished by water into a natural "dagger".

Ivory too tends to cleave into natural plates in the course of centuries, and it is very often mistaken for a yellow-wood. The superficial appearance is much the same as this tree, or a local boxwood, but the flakes or plates are far more delicate, and should be handled with the utmost care, and carefully packed and preserved. Every piece should be carefully collected, as the whole will probably build up into a rare carved piece. This will be referred to once again under Preservation and Packing.

9. Tortoise shells. Until tortoise shells have been identified and studied by the finder, they are liable to be collected as fragments of human skull. The sutures or joins of the bones are superficially similar, but the shell has peculiar veining on the carapace, which underlies the integument or "shell." This latter quickly rots away with exposure.

Once again let me suggest that local collections of these many "Sources of Error" be made, and if possible identified by a competent geologist. They too have their interest.

VI.

ELEMENTS OF TECHNOLOGY

Were that not a botchy core.
Troil. and Cress. II. i.

Prehistoric man learnt the uses of stone as a material for making implements at an early stage. Stone affords a hard, heavy material that can take an edge for cutting, chopping, scraping or trimming. Its particular adaptability depends upon its hardness and texture, so that each type of stone has its appropriate uses. Yet it would seem that man slowly learnt this fact late in his story. Before this development, tools were made from the hardest and most flinty stones available locally, and the implements themselves were unspecialised. Later we find that glass-like obsidian or flint was used for points, chisels, scrapers and blades, while sandstones and gritstones were preferred for sharpening other tools or for making grindstones, while soft ochres were used for paint, and soapstone, limestone and talc provided material for carving.

Apart from hardness and texture, the internal structure of a stone varies. Slates, schists and certain sandstones and shales have layers that affect their cleavage or split, somewhat analogous to the grain of wood. White quartz and obsidians that have been affected by heat (so that a state of tension exists within the mass) will shatter when struck. Stones that are homogeneous, and have an internal structure not greatly affected by the stresses induced by crystallisation, heat action, or their stratified or schistose origin, will show definite laws of cleavage or fracture. It is quite obvious that prehistoric man observed those laws and habitually made use of them to shape his implements. They were as substantial to him as the splitting of wood is to the woodcutter of to-day.

Rock fracture

The fracture of a rock results when any stresses become excessive, and it can generally be attributed to three or four causes: Desiccation, Thermal Fracture, Pressure and Percussion.

Desiccation occurs in certain mudstones, but could not be used by primitive man. Thermal fracture is induced either by the stresses and chemical action set up by extreme heat, or else by the mechanical action of alternating heat and cold. Thus sandstones may be reduced to sandy granules, while limestone may be reddened and calcined, and obsidian may shatter. Grass-fires and hearths will constantly produce these effects. Insolation, or the sudden contraction and expansion of stone, due to frost or rain after intensive sunshine, causes heat-spalling. The cleavage is typical, and shows itself as a concave face on the flake, and a convex surface on the core. (See Thermal Action p. 61.) Pressure and percussion are similar in their action, and it is impossible to differentiate between them with real certainty. Both consist of the application of a load at a point, heavier than the material can bear. The essential difference lies in the presence or absence of "carry through" or "follow through" by the impulse or force causing the fracture. Both may be produced by purely natural action in a haphazard manner, by tectonic movements, ice-pressure, the falling of rocks or by lightning. Both are generally products of outside forces, though pressure can be produced by the freezing and expansion of water enclosed in stone under cold conditions.

Cone of percussion. If a slab is evenly bedded and a blow struck at a point in the middle of the exposed face, one of two things will happen. Either the stone will merely "star" into three, six or twelve equiangular fragments, or else, immediately below the point of impact will be found a wide-angled cone, point upwards and coinciding with the point of impact of the blow. This "cone of percussion" is generally embedded in the slab, which may have to be broken again to release it. The cone is truncated at the top, coinciding with the area of the impact. From here it cleaves in a wide angle (about 105° in specimens I have measured). As the force of the blow dies, the cone may narrow, usually to an angle of 75°, while the irregular distribution of the forces set up by the blow may produce a series of ripples, sometimes more or less regular, sometimes fiercer and more turbulent on one side of the cone. The change of angle of the cone may be sudden, giving a somewhat

hutshaped cone, or it may be smooth, giving a beehive or mammaeform cone.

This experiment gives us a clue to the laws of fracture. A load (percussion or pressure) applied at a point radiates force in a right-angled cone whose axis coincides with the direction of the force. In other words, a right-angled conical fraction is compressed until the stress is too great for the material to bear, and cleavage occurs between the compressed and uncompressed masses.

When we apply our load toward the edge of the stone we get an analogous effect, but the nearness of the edge of the core gives a line of lesser resistence, and the cleavage is modified. The cone is now distorted into a "bulb of percussion", and the flake so removed shows a typical conchoidal or shell-like cleavage, like the hinge portion of a Donax shell, a mussel or some similar bivalve. This cleavage is, of course, reflected on the "core" or "nucleus", the parent block from which the flake was struck, so that the bulb is here marked by a depression called (somewhat surprisingly) the "negative bulb of percussion". The direction of the axis of the force applied, the proximity of the wall of the core, and the chance directions taken by the ripples of uneven force, will all help to govern the shape and the cleavage of our flake; but the fundamentals are the same, just as the fundamental laws of water rippling are the same, no matter what incidentals divert the waves. If our blow is nicely gauged, and the materials happen to be homogeneous throughout, a minimum of rippling will occur, and bulb and cleavage will be smoothly rounded. A flake so produced we can call a "standard flake", and we can analyse the cleavage of this flake and its variants.

Analysis of Flake (Fig. III.)

A. Section showing Striking Platform (S.P.), Wall (W) and Cleavage (C).

B. Flake scar, showing (1) Negative of bulb with fissures, rippling, etc., as seen on the core or nucleus.

C. Flake showing (2) Positive bulb with fissures, on flake.
(3) Rippling.

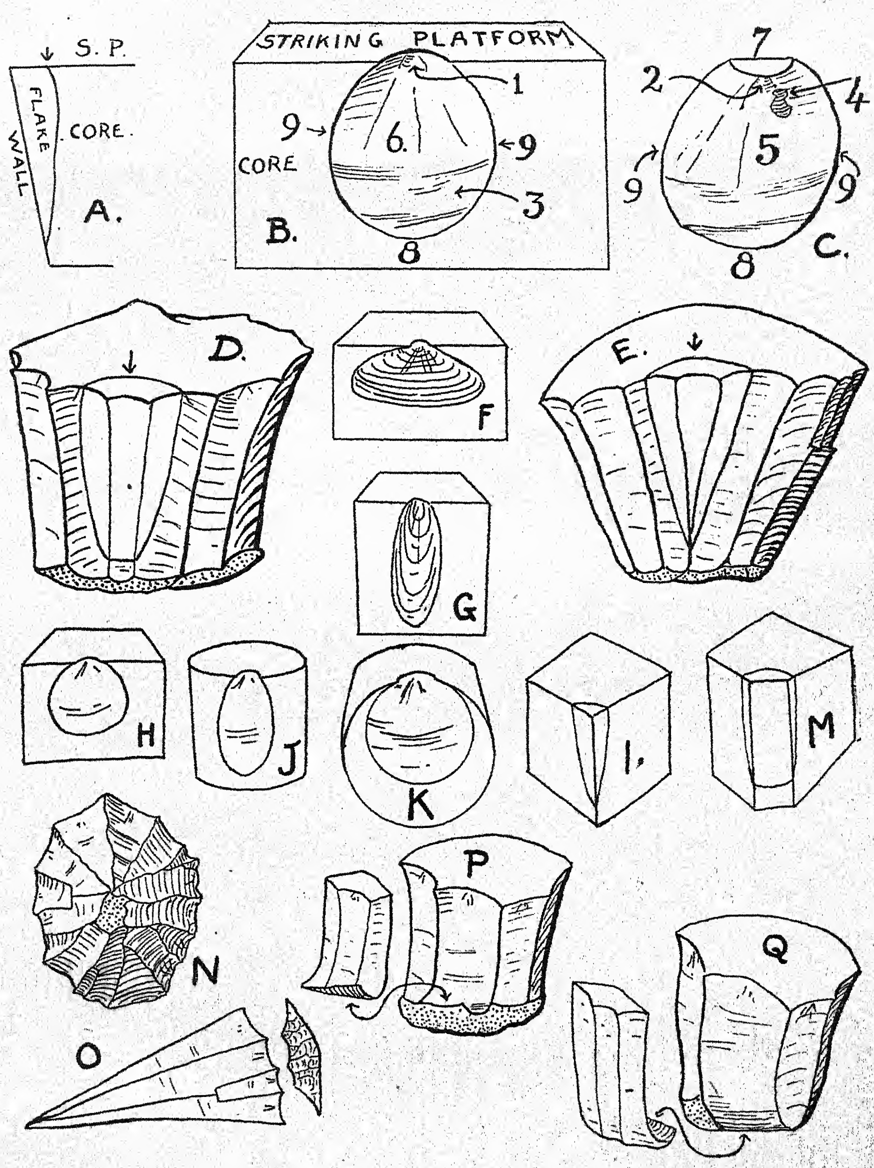

Fig. III.
Illustrating laws of fracture as used in making stone tools.

(4) Bulbar scar.
(5) Cleavage face of flake.
(6) Cleavage scar on the core.
(7) Hinder or bulbar end, forming the Butt.
(8) Forward or end-release of cleavage.
(9) Margins, lateral releases or borders. (Do not use the ambiguous word "sides".)

D. Outer face of prepared core, showing longitudinal parallel flake scars, separated by parallel ridges or arrises, that result from a plain striking platform.

E. Outer face of prepared core showing simple convergence of ridges or arrises, resulting from the use of a curved striking platform, often "prepared" or trimmed to shape beforehand.

These drawings have been prepared to show an approximately standard flake, and if this were struck from the edge of a cube, both flake and scar would be approximately circular in plan (fig. B. and C.). There are two important variants, and both the Spread Flake (F) and the Elongated Flake (G) may show more rippling than the standard flake. They result from the particular direction of the axis of the blow, the presence or absence of '"follow through", and other causes that are not completely understood.

F. The spread flake has been struck too much into the body of the core. The bulb approximates more closely to a half-cone. The flake often snaps across instead of continuing to a true release. This gives the Stepped or Resolved Flake. A stepped flake can be induced by holding the stone firmly a little below the point of impact of the hammer, in which case the flake will snap off above the point held.

G. The running or elongated flake has more "follow through" to the blow, and is roughly perpendicular to the striking platform. The bulb of percussion is present, but is often flatter than in the standard flake. This form of flake, by

reason of the "follow through" can be a product of sustained pressure with a bone tool, or may even result from the use of a wooden mallet or billet, or a hammer of hard wood, bone or horn.

Experiment with these fractures. The chipped edge of a cup or a tumbler will show you the habitual form of the fracture, and even here the bulb of percussion can often be plainly seen. A steel hammer with a rivetting pein; a horn or tough hide hammer, a bone tooth-brush handle and some fragments of heavy plate glass will provide all the material necessary. Take trouble to notice the form of chips knocked off the mouths of bottles, glasses, and so on. They all conform.

We need hardly go deeply into the question of the application of the standard flake to variously shaped solids. (Figs. H. — M.). It is enough to say that the form taken by the flake is governed entirely by the outer wall of the core. The cleavage is standard, no matter what the shape of the core may be (within very wide limits). A very simple analogy is the cutting of bread or cheese. The slice will be shaped not by the cut, but by the form of the surrounding edges.

Here are four simple experiments that can be made to study the laws of fracture, and repeated until the laws are understood.

1. Mould a cube of fairly solid gelatine. Make a small incision with a pin at a point corresponding to a point of percussion near one edge of the cube. Place a finger at the incision, and pull away a flake, watching the cleavage. Pressure exerted vertically will produce a spread-flake; a steady pull away from the block will yield a running flake; and a force, half pull, half pressure, will give a standard flake. This provides us with a very important clue to the control of fracture.

2. This is an odd experiment, reducing the laws of fracture to two dimensions. (a) Take a series of sheets of paper, about 10″ x 5″. Nick the long edge of the first sheet an inch from the corner. Hold the paper three-quarters of an inch on either side, and tear. Repeat this with a series of nicks an inch apart. The tears will tend to lie parallel. (b) Take the other papers, and on the first make a nick at one inch, on the second two inches from the corner, on the third three inches, etc. Holding the

paper this time at the extreme ends of the side nicked, tear each paper separately and with care. Contrast the tears with those of the first sheet. It is the first of these two experiments that conforms most closely to the cleavage of a series of flakes. The direction of the forces producing the tear here reproduces the inertia of the core; in the second experiment the centre of inertia is several inches away from the point of "cleavage".

3. *"Turning the edge"*. Take a piece of quarter-inch plate glass. (a) On one face near the edge, strike a series of blows to remove small flakes. Note the angle of their cleavage in relation to the face of the glass which formed the striking platform. (b) Now turn the glass over and do the same thing from the opposite face, but this time use the scars produced in the first experiment as your striking platform. The face of the glass is now your outer wall, and the angle between this and the striking platform is acute; observe the markedly different flakes you obtain.

4. Take a rough cube of glass, obsidian, flint, chalcedony or a similar homogeneous rock. Mount it in a vice, insert a steel ball-bearing between the rock and the jaw of the vice, and screw the vice until cleavage takes place. Study the fracture.

There are two variants of normal flakes that occur fairly frequently, the Hinged flake (P), and the Plunging flake (Q). In the former the cleavage has taken a sudden turn towards the outer wall to produce a neat hinged effect. In the latter the cleavage has taken a turn underneath the core, undercutting it. This is partly due to the proximity of the underface.

Variations in Material

While the laws of fracture are the same for any one homogeneous material, the relative strengths of different elements of cleavage vary slightly with different materials. During the course of almost annual class-experiments over the last twenty years, I have noted that in flint, obsidian, chalcedony, quartz crystal, clear white quartz, smooth surface-quartzite and in glass the bulb is small, marked and well-rounded. Radial fissures are not very apparent, except in transparent glass and obsidian. The bulbar

scar is often small or absent, and rippling takes the form of distinct and fairly regular waves. Indurated shale shows a marked bulb, marked radial fissures, but not much rippling unless the shale is intensely black and lustrous like a porcelain.

In Table Mountain Sandstone (the typical quartzitic sandstone of the southern mountain region of the Cape) the bulb often merges into a shallow saucer-like depression on the core and is often quite difficult to isolate. Radial fissures are absent, rippling is very rare, and hence hinged or plunging flakes are not common. There is a strong tendency to step or resolve, often leaving a marked and uncomfortable "island" of stone on the face of a rejected implement. Some quartzitic sandstones would seem to have retained some remnant of their original laminations, and so cleave somewhat more flatly in the general direction of the stratification.

In dolerite and similar igneous rocks, the bulb is hardly defined, and merges into a deep saucer-like depression on the core. Rippling starts smooth and rounded, but rapidly becomes erratic and marked. Shattering and marked fissures are present about the point of percussion. Hinged and plunging flakes are common. The almost metallic ringing note that is evoked when the stone is struck shows the presence of strong vibrations. These are sometimes so intense that it is possible to suspend an elongated piece of dolerite by its centre, strike a blow towards one end, and remove a flake at the opposite side of the point of suspension. This odd fracture has, of course, no bulb of percussion, but may show rippling.

Bi-polar flaking

If a pebble is placed on another stone, and struck with a third, as though broken between a hammer and an anvil, a variant of normal fractures occurs, as the pebble is virtually struck simultaneously from above and below. Two cleavages can occur, each starting from a bulb of percussion set at opposite poles of the pebble. One face of the cleavage shows two opposing bulbs, negative or positive, and the other cleavage face will show one bulb of percussion. Between the two halves of the split pebble a wedge of stone will fall away, sometimes bearing a single

bulb on one face, and two on the other. Alonzo Pond has illustrated this from experiment.

The Abbé Breuil says that this sort of very simply split pebble was found profusely in the cave inhabited by Sinanthropus near Peking. He adds that it is also generally indicative of natural fracture as it is found in river-gravels and raised beaches, as a result of earth pressures. This must be carefully watched, as it may well prove a source of error in the field. Two other factors had to be evoked to provide the necessary proofs that the Peking specimens had been used by this ape-like man: all the quartz pebbles used were "foreign" (brought to the cave), and in addition there were great quantities of ash from properly maintained hearths.

Bone rests

The use of a bone rest (anvil is a term also used, though we have no bi-polar effects here) was common in Europe even before the Middle Palaeolithic, when many large splinters of bone are found to bear indentations and scratches caused by "rest percussion". The bone was used in much the same way that we might use a bench, to steady and support the artefact while fine percussion or pressure was used. The American Indians employ a cross-section of a tree trunk held between the knees.

Indirect flaking

Indirect flaking is not discernible on the tool itself, but it seems to have been common among the American Indians, according to Pond, Holmes and others, and it is highly probable that it was a prehistoric technique in general use. The method consists in using a "cold chisel" of bone or stone between hammer and artefact. The implement is rested on the heel of the left hand, and the chisel or presser is held between the first and second fingers of the same hand. It is adjusted to a nicety, then struck with the hammer. At some South African sites (e.g., Aliwal North) finger-like stones have been found showing signs of usage at the ends, that could only have been produced by use for pressure-flaking or by indirect flaking of this type. Bone or stone chisels used in this way can be expected to show signs of usage.

The core and the flake

Prehistoric man made use of the laws outlined above in making his implements, and understood them, not in scientific terms, but as naturally as we understand the rules that govern the splitting of wood. These laws were most important to him, so he observed them far more carefully. They were not formulated laws but were simply learned during youth from older men. In making tools the laws of fracture were appropriately applied. Tradition taught the application, and little deviation occurred over long periods, provided that suitable materials were available.

The making of an implement never took more than a few minutes, except for example in the case of very beautiful tools in certain specific periods, but even here an hour's work produced the most intricate examples. It was not the chipping that took the time but the tremendous wastage. W. E. Roth in the most important document so far written on implement making points out that chipping takes a matter of seconds, but that perhaps 300 wasters or rejects may be struck before a suitable tool is produced. These rejects are left on the site, while the one product of the day's work is then taken away, mounted in *mindri* pitch, and used until it breaks. Even then it is not a one-purpose tool, but serves a variety of needs, until it is discarded well away from a chipping site. The tools he describes in Australia of to-day are directly analogous with our Middle Stone Age Still Bay and Mossel Bay types. The heavy deposit of flakes that occurred in the type cave at Mossel Bay obviously presents a similar state of affairs there.

Where a block of stone has been trimmed to shape and the spalls or flakes are discarded as useless, we often speak of a *core implement*. The discarded flakes are seldom used. On the other hand a core that has been shaped with the intention of striking off suitable flakes for knives, points, etc., will be eventually discarded, and the flakes will be made into tools. These we call *flake implements*.

This way of differentiating is a very general one, and it is obvious that where a large flake has been struck from standing rock and has subsequently been used as a core implement, or

even as a core for the removal of flakes, this difference hardly exists in fact. For this reason two other terms are sometimes used. They are not the equivalents of those given above, but augment and clarify those terms in certain instances. An implement that shows "secondary working" (work done after the primary trimming of the flake, and its removal from the original core) on one face only is called a *unifaced* tool. The work is normally on the outer face of the flake, and seldom on the cleavage face. If both faces show this type of workmanship, whether it occurs on a flake tool or on a core tool, the implement is spoken of as *bifaced*. In many cases the true origin of a bifaced tool is completely obscured by the working on the two faces, so that we cannot identify it as of core or flake origin.

VII.

THE EVOLUTION OF TECHNIQUES

We'll make an instrument of this.
Winter's Tale. IV. iii.

We must differentiate between a technique and a culture. Technique is a traditional method directed towards an end: it consists of the accepted method of achieving the desired result. In some cases techniques run like threads, binding various cultures together, cutting across time and space. They are therefore even more important than the more static concept of "cultures". I have grouped them here into various series, but these have no exact relationship to chronology or to different areas. In some cases two techniques occur side by side on the same site, from the same period. In others a technique will disappear in one area for vast spaces of time, then suddenly reappear in a developed form. Whether this implies persistence elsewhere we do not yet know, but the possibility of reinvention is unlikely where the technique is at all complicated.

THE BIFACED SERIES

Abbeville Technique

This covers most of man's earliest conventionalised tools. The intention was to make a roughly almond-shaped tool, 4″, 6″ or even 10″ long, and of proportional width and thickness. In Europe a suitable flint nodule was taken, though elsewhere a smooth river pebble of the right size was substituted. (1) The perimeter would be chipped from one face, with flaking somewhat like the first series of chipping we tried on plate glass as an experiment earlier. (2) The stone would then be turned over, and a second series of flakes struck, this time using the first flake scars as a striking platform ("Turning the edge.") These would be radially convergent, covering the whole face of the

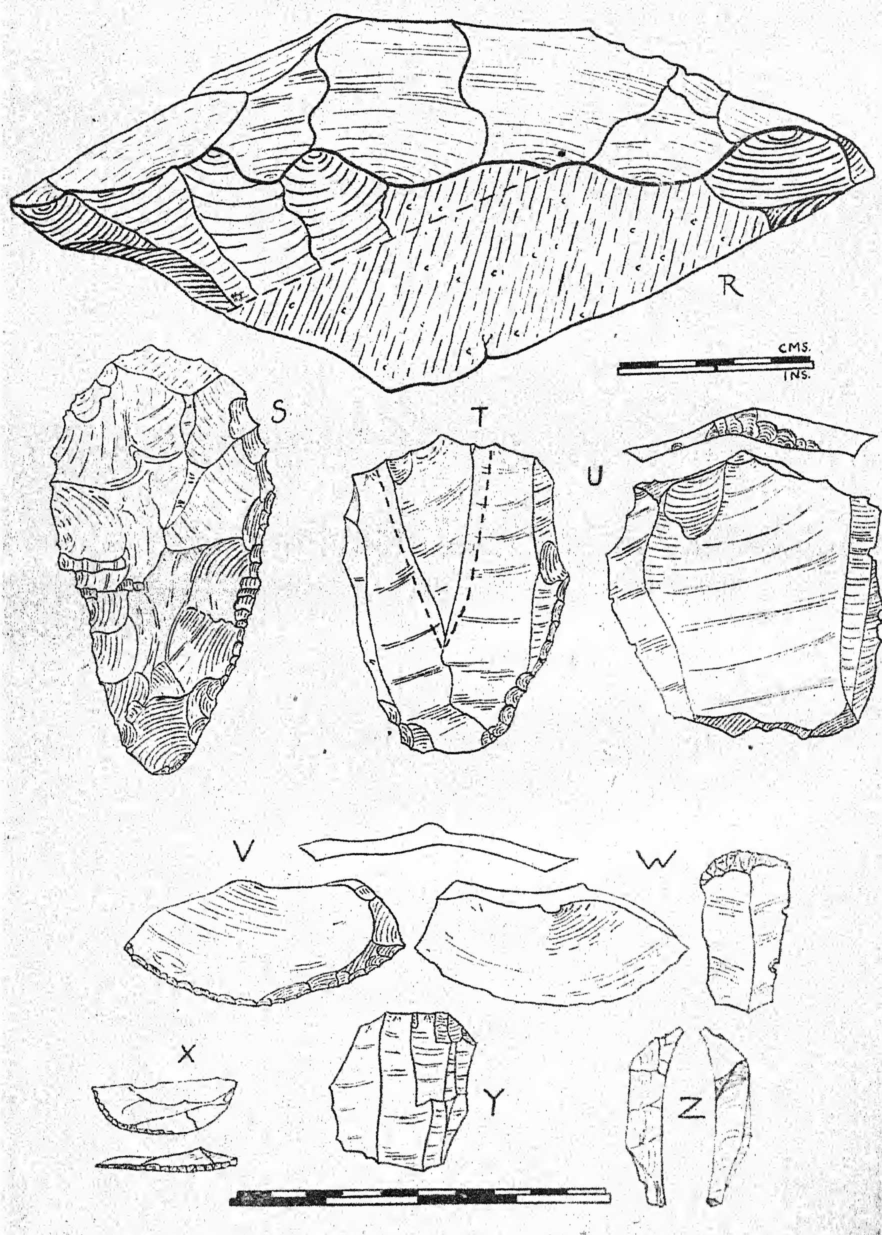

Fig. IV.
Examples of primitive technology in the use of stone.

pebble. (Fig. N.) (3) The stone would be turned once again, and the process repeated to trim the opposite face. In general the earlier the culture, the less trouble was taken; though this can only be seen in the best implements from each site. The maker would eventually have a crude almond-shaped tool of the size he wanted. It would be surrounded by a somewhat wavy edge, and was suitable for digging. In later phases, when such an implement was made, a flake was used instead of a pebble, but when a pebble was used the first series of flakes (those preparing the platform for later flaking) was generally unnecessary. The finished implement has a variety of names, hand-axe, amygdal, *coup-de-poing*, *boucher* (now dropped) or *faustkeil*. The popular name in Afrikaans seems to be amandelklip. (Fig. S.)

The spalls struck off in the later chipping processes will bear facets from the chance striking platforms that resulted from the earlier process of trimming. These are discards, and only in a very few cases do they show signs of usage on their worn edges. In the earlier periods flaking was done with a stone hammer, making short, wide, crude flakes, that were reflected in the coarseness of the trimming. In later times the makers seem to have made use of a wooden or bone hammer fairly generally, yielding elongated, narrow flakes, with more "run" to them. This smoothed the finished implement very considerably, and with care a very beautiful almond-shaped tool could be made.

Tachengit Technique

At Tachengit in North Africa, and at numerous other sites in Africa, we find the blanks for almond-shaped tools made by a different process. I have collected them in Spain and North Africa, and Leakey describes them from East Africa. They show a development that is typical of areas where raw material was better available in the form of standing rock than as pebbles or nodules. A large suitable mass of stone was used, and great flakes were struck from these. In some instances a suitable platform might be prepared, and rotted cortex hacked away. Using this striking platform a few haphazard flakes would be struck with little attempt at neatness or economy. The most suitable flake would then be trimmed in much the same way as the pebble described above. If the flake were rejected at any

stage during the process, it would show a wedge-shaped edge, either across one end, or along one edge of the tool. Whether these habitual rejects, roughly resembling the modern axe, were ever consistently used, I do not know. They are very typical of factory sites, but of the thousands I have seen only a half dozen suggest usage along this edge. The form is however just as important technologically whether it is a true tool or a habitual reject. It shows the flake origin of the tool in a way that the completely flaked tool will not. This form is generally called a cleaver, *biseau* or *hachereau*, etc. In general this Tachengit technique is associated with the use of a wooden or bone mallet, suggesting relative lateness, though the use of a wooden hammer to some extent overlaps the Abbeville in South Africa.

Further examples of bifaced techniques will be discussed under the heading "Laurel leaf".

THE LEVALLOIS SERIES

Victoria West Technique

In Europe Breuil suggests that the Levallois is a development from the Tayacian. Whatever the origin may have been there, there is no room for doubt in Africa. The Levallois is here the logical outcome of the Bifaced Series. The first stages were observed by Jansen at Victoria West, and were later found in the Vaal gravels at Kanteen Kop and elsewhere. Here the direct relationship to the Abbevillian becomes obvious. Briefly, a great, heavy *coup-de-poing* was taken. It was about ten inches long and of suitable width and thickness. It was made thicker than the normal *coup-de-poing*, and only the one face was carefully prepared. (Fig. R.) Virtually only stages 1 and 2 of the Abbeville technique were employed. Using the flake scars of stage 1 as an appropriate striking platform, a single blow was struck in such a way as to remove almost the whole of the prepared face of the stone. The core was discarded. The flake was now trimmed along the free edge, and thus passed through a scraper-like stage, as this edge was trimmed by a series of "stepped" or "resolved" flakes. Like the cleaver, this form seems to have been a habitual reject; but this is no reason for failing to collect specimens.

They represent examples of a distinctive stage through which the various types of *coup-de-poing* must have passed. (See Goodwin under D. in Bibliography.)

Levallois Technique (Fig. U)

This is first evident in the second stage at Victoria West and Kanteen Kop. There is little real advance, save that in a long period of development the cores pass through a number of shapes, but in each case a special platform was prepared at a spot selected as most suitable for striking the final blow. This striking platform was prepared by the removal of small, light flakes (faceting) which are still evident on the flake struck from the core, forming a prepared butt. (Fig. R.)

In Europe, Africa and Asia the Levallois series covers a number of cultural periods. In South Africa and in India it appears early in man's story. This is accounted for by two things. Western Europe is essentially a flint area, and the small irregular nodules are more easily made into *coups-de-poing* by the Abbeville technique. This cut out the Tachengit and the proto-Levallois techniques as European stages. But in addition to this, Europe was isolated from the rest of the world during the prehistoric period by succeeding glaciations, forming the Quarternary ice-age. Ideas and techniques may therefore have failed to filter through until interglacial periods rendered the climate more amenable. The Levallois series precedes the last glaciation, but the whole series in Europe seems to show a lag that continues up to the metal periods.

As the Levallois developed, man learnt to use and to re-use his cores until very little remained of them, producing smaller and smaller flakes. There is also a general refinement of the flaking technique as the series continues.

Developed Levallois Techniques (Fig. T)

The Cupid's bow butt (*chapeau de gendarme*) is a development from the ordinary Levallois. Its peculiarity lies in the preparation of a curved butt (striking platform) ending in two shoulders, by the removal of a series of faceting flakes. The central curve provided the platform for the removal of simply convergent flakes to trim the core, but the two shoulders allowed

the removal of a pair of limiting flakes, that helped to prevent the lateral spread of the final flake. (Fig. U.)

The simple curved butt is a simplification of this. It was apparently found that a better Mousterian point could be got by making the core narrower and better shaped, usually shield-shaped (scutiform) or heart shaped (cordiform). The striking platform consisted of a plain trimmed curve, from which simply convergent trimming flakes were struck, and the final flake achieved was a simple point, struck in such a way as to leave one ridge, or two convergent ridges down the outer face of the flake to give greater strength and a sharper point. (See Figs. E and O.)

The Aterian and Sibelian techniques in North Africa are merely slight developments from this. (Fig. T.) Here the typical "tortoise core" is scutiform, and the flake that resulted was finally trimmed in such a way as to leave a distinct tang or peduncle at the hinder end of the flake, presumably for hafting.

Grand Pressigny Technique

This may perhaps be an independent invention. It is quite definitely related to the Levallois technically. It is a logical and highly specialised development following an apparent lapse of time since the final Levallois of Europe. It seems only to have been possible with a certain type of flint, though possibly a fine-grained obsidian or chalcedony might have served as well. The thousands of years that seem to divide the Grand Pressigny from the parent Levallois may well have been bridged outside Europe.

A long core was prepared by having numerous lateral flakes struck from each border. A more or less flat striking platform was prepared by faceting, and finally a single magnificent flake, long, sharp and dagger-like, would be struck from this platform at the end of the core. On its outer face the flake shows the scars of the trimming flakes, forming an irregular ridge down the midline. A second or third flake might be attempted from the same core. So far as I know this technique is confined to France.

PLAIN-BUTTED SERIES

Clacton Technique

In Europe this is early. It seems to have had a more important place there than elsewhere, though it is widespread in

Africa. A core was prepared with a plain striking platform, by the removal of a single flake. This platform was now used to strike off plain-butted flakes. The flaking was haphazard and brutal. The forcible striking of the flake produced a very marked bulb of percussion (often resembling a half-cone) and there are marked ripples and fissures. The angle between striking platform and cleavage is wide. Almost all the examples known are from factory sites, and little is known of finished implements. This was certainly a wasteful method, as little attempt was made to "place" the blows. Later stages suggest that a wooden billet was eventually used in this process also.

La Quina Technique (Fig. V)

The so-called "Mousterian" of La Quina shows a refinement of the Clacton. A plain striking platform is used, often consisting of the untouched cortex of the flint. In certain cases flaking is haphazard, but now and then we see an attempt to remove one flake directly behind another (V). The result is an odd flake, one face convex, the other concave ("Concavo-convex"). The edge is trimmed with typical resolved or stepped flakes, similar to that used in most Middle Palaeolithic cultures. The South African Smithfield A. material often shows clear analogies.

Blade Technique

This is sometimes called the "Neanthropic technique", a bad phrase, as it implies that it is, in every case and every area, to be associated with our own species of man, *Homo sapiens*. Following Burkitt's use of the phrase "blade and burin" cultures, I prefer to use the description "blade technique".

In essence it consists of the most economical use of a core with a plain striking platform, (Fig. Y.) in such a way as to produce a number of consistently parallel flakes: the outer face of each is fluted by the cleavages of previous flakes. The core in its most perfect form (Mexican obsidian users made the finest examples) resembles a beautiful fluted column, or the base of an upturned fluted tumbler (Figs. D. and Y.). The flakes struck from such a core are generally so planned that each bears two parallel ridges (forming the primary trimming) down its length, a form that

permits the utmost economy in the use of the core. This technique for procuring blade or end-scraper blanks, is generally typical of most Neanthropic periods in Europe, Africa and Asia, and is generally typical of American blade industries. In Australia it seems to be employed alongside earlier techniques even to-day. These blanks may be trimmed along one edge, usually with a backing technique, or may be chipped across the end to make a chisel-like endscraper. (Fig. W.)

SECONDARY OR TRIMMING TECHNIQUES

The Laurel-leaf

As has been suggested above, this is a development related in origin to the Abbeville series of bifaced techniques. It consists of taking a blade or a flake with convergent flaking, and trimming it in such a way as to produce a thin bifaced implement, generally symmetrical, though not necessarily so. It is generally believed that this was done by pressure, that is by pressing off flakes from the edge of the implement in such a way that they "ran" over the face of the tool. Breuil has come to the conclusion that the blade was rested on a wooden block, and chipped with a hammer. Work is done from the edges inward, and flaking continued until the whole of both faces of the tool were completely covered by fluting, so that the flake origin of the blank is lost. In Europe the technique appears in the Solutrean period, when the original flake used had a blade origin. In the Still Bay culture in South Africa and elsewhere it is typified by the use of a Levallois flake. In Europe the Solutrean eventually gave the *point-à-soie* (single-shouldered point), laurel-leaf, willow-leaf, etc. In Egypt from the Badarian onward we find an increasing refinement, which produces many surprising forms. It demands excellent material, and it is possible that many of the South African forms, which we regard as more primitive than the Still Bay culture and perhaps parent to this development, are really crude attempts to undertake a traditional technique in a completely unsatisfactory material.

Where a flake does not merit working over the entire cleavage face, it may sometimes only be worked in such a way as to reduce

the bulb of percussion, in order to "streamline" the lance-head. In Europe the earliest appearance of the technique seems to have been in E. Pittard's little-known Festons shelter in the Dordogne valley. Here material, which is reputed to be an "advanced Mousterian", shows the only analogies I have seen to the Still Bay techniques. The shelter takes its name from the discovery of coarse denticulate flakes ("oak-leaves") exactly resembling our own Still Bay forms, and similarly made from blanks struck from developed Levallois cores.

Resolved Flaking

The use of resolved or stepped flaking to provide a strengthened edge to an implement starts in the Acheulian of Europe, and in analogous periods in South Africa. Blows were struck directly at the edge of an implement (either core or flake) in such a way as to snap off about 5 mm. from the edge, leaving a marked step parallel to the edge of the tool, often on both faces if the tool were bifaced. (Fig S. at right-hand edge.) On flake tools similar methods seem to have been employed on one face only. This occurs in the European Middle Palaeolithic and the analogous South African Middle Stone Age. In many cases implements were chipped along the edge on one face only to produce a series of wide step-flakes, resembling little eyelids. This is mainly typical of certain fine-grained materials. The intention was apparently to produce a fine saw-like edge. It is important to note that much the same sort of "eye-lid flaking" is produced by certain types of usage.

Fluting

The removal of a series of small, parallel flakes from the edge, or more often the end, of a flake to give a plane-like or chisel-like edge, is typical of the endscraper (Fig. W.) and other forms made on blades. This is to be observed in the European Aurignacian, Magdalenian and Neolithic periods, in the North African Capsian, and the South African Later Stone Age techniques. Generally the end of a blade, or even some part of a worked-out core, will show a chisel edge made in this way by removing a series of flakes to leave a cutting edge of about 45°.

Backing (Fig. X)

The intention here seems to have been to give a blade a non-cutting, blunted back, very like that on a modern penknife. The flake was placed on an anvil, and by a series of sharp taps with a small hammerstone double-bulbed or bipolar flakes were removed across the thickness of the flake. One bulb is of course formed by the anvil and the other by the hammerstone. This process can be very easily reproduced along the edge of a splinter of glass, but care must be taken not to crack the glass across its width. Backing was also at times achieved by nipping off fragments with a notched bone tool, exactly as a glazier does with the notched edge of his diamond cutter. (Cf. Notching, below.)

Burins

The term burin covers a variety of different tools, each of which is characterised by the presence of a small transverse graver-like edge, formed by the intersection of a prepared portion of the flake (less frequently a core) and a single carefully directed cleavage, removing a fragment of the edge of the flake. The way in which this "burin blow" was achieved is excellently explained by Leakey. According to him a suitable flake would be taken, and the prepared tip inserted firmly into a wooden block. The butt end is held, and a sharp blow struck against one edge of the flake. The flake breaks in such a manner that one end of the cleavage coincides with the point of impact, while the other runs down into the wooden block. The burin splinter struck off (*coup-de-burin*) is very typical, and may be called a burin waster.

There are a vast variety of burins recognised, generally depending upon the preparation of the part of the blade where the burin is intended. The wasters occur in profusion where burins are present, but are of no great archaeological value.

Many so-called burins are chance products of rough usage, but when Breuil was examining Colonel W. E. Hardy's collection he pointed out that certain "pseudo-burins" had every appearance of intention, and were probably artefacts with a very similar intention behind them. The most certain sign of the true burin is resharpening, which may occur again and again, though it does not appear on every specimen. This shows itself in a series of steps down the edge of the tool. Leakey regards the burin as having its origins in the Acheulian period in Kenya and Europe, but it was certainly rare, and was possibly a product of usage.

TECHNICAL ODDMENTS

Microlithic Techniques

The various microlithic (small-stone) cultures are certainly part of a single Old World dissemination preceding the Neolithic spread. The term Microlithic does not merely mean that implements were small; it covers a number of technical elements held in common:

1. The use of blade technique for obtaining flakes.
2. The flake was snapped into two or more fragments, and the bulbar piece was discarded, so that a relatively flat piece of the flake could be used to make the implement.
3. A backing technique was employed to shape the flake further.
4. Geometrical forms were preferred.
5. Sometimes the "micro-burin" is included in the series; in these a sliver of stone was twisted off the working end. It it is more than likely that this was a product of usage in a number of cases, but it is typical of the microlithic series in many parts.

The microlithic techniques form the Mesolithic or Epipalaeolithic cultures of Western Europe, but they are consistently found from Japan, through Indo-China, Ceylon, Egypt, East Africa, to the Union and the Cape of Good Hope, apparently the products of various coastal spreads, with associated movements inland from time to time. The lack of information from inland areas is largely due to lack of searching.

Redirecting Flake

This is likely to occur in any technique in which a series of flakes is struck from the same core; apparently if a worker found the flakes he was getting unsuitable, he changed the direction of his blows to a new platform at right angles to the first. The first blow in this new direction removed the edge of the old striking platform, and subsequent blows removed flakes parallel to this. The first few flakes thus show flake-scars running directly across the flake.

Platform Renewal (Fig. Z)

This flake is very similar to a redirecting flake, but generally has more of the platform and less of the fluting of earlier flakes evident on it. This again is likely to occur in any blade-making culture. After a series of flakes have been struck from a core, the angle between flake and striking platform may become too acute. All that is necessary is to prepare a new striking platform by striking a blow at one end of the original platform, to form a new striking surface. More blades may now be removed from the original core. This was also done in cases where a careless worker or a bad stone produced consistent step-flaking instead of yielding long blades. These steps build themselves into a line of resistance and future flakes will break off at the same point. This can only be rectified by removing a platform renewal flake, on which the scars of the stepped flakes are visible. This sometimes resembles a "quarter-lemon".

Notching

Simple notching is very frequently a product of usage, and quite slight leverage will remove semi-circular bites from the edge or end of a flake. This places such flakes into the "instrument" class, as breakage of this sort can hardly be premeditated. Trimmed notches fall into a different category, and are generally called notched or hollow scrapers, presumably used by prehistoric man, as by the Bantu to-day, for scraping such things as knobkerry and spear shafts, and for trimming walking sticks. Notching may be a product of a notching tool, two bones spliced together to form a nick for leverage like those provided on a glass-cutter.

Underflaking

This term is used to describe secondary trimming, made from the outer face of a flake in such a way as to produce the flake-scars on the edges of the cleavage face. Dr. J. Hewitt has called this "Kasouga flake", owing to the numbers of flakes of this sort found by him at the Kasouga River mouth.

Grinding and Polishing

The grinding of tools to produce a cutting edge, in contrast to the results of usage, is a Neolithic element. This does not necessarily mean that its presence will in itself constitute a Neolithic culture, any more than a red blanket will constitute a European culture. It may be an independent or borrowed element, or even a separate invention, an independent development of the grinding and polishing techniques universally applied by man to his bone and ivory tools. In the Congo, Dr. F. Cabu differentiates between ground and polished axes, grinding being far coarser and cruder than polishing. There two stages in the Neolithic are differentiated by this means.

Enough has now been said to supply the general basis of prehistoric stone technology. All that is essential is to apply the knowledge so gained to hundreds of examples (with due scientific scepticism) until each technique can be recognised and understood in a variety of forms and in many materials. To become expert it is essential to handle and appreciate large numbers of examples. No amount of reading will teach as much as a museum of specimens and a good teacher. Attempts to make implements from porcelain or glass blocks (insulators, etc.), while tricky, are instructive and amusing.

VIII.

FIELD RESEARCH

We'll sift this matter further.
All's Well. V. iii.

It must be remembered that the Union Government Notices Nos. 1571 and 1572 of September 20, 1938, virtually prohibit the excavation of any stratified, enclosed or defined archaeological sites, or the removal of material from such sites, unless certain defined regulations are complied with, and permission has first been obtained from the Historical Monuments Commission, c/o The Archaeological Survey, Witwatersrand University, Milner Park, Johannesburg. The intention is to debar irresponsible amateurs from destroying enclosed sites, but at the same time it permits them to learn something of the technique of excavation from certain unstratified open-air sites. It does not debar excavation by a competent person, but insists that a permit be obtained, and that material so excavated shall not be wantonly destroyed or exported to the detriment of local science.

In order to learn scientific method, we may therefore approach our subject by dealing with those types of site that are permitted to the amateur with an inclination for this subject as a hobby, and the leisure for local work. To such a man I would suggest that he work a single site conscientiously and carefully, making it the study of years. Such work has brought merited fame to workers such as Kannemeyer, Hardy, Heese, the Peers, Leith, and a dozen other pioneers. The worker should keep detailed and careful notes in a quarto or foolscap carbon book, writing up his finds fully and in detail after each visit to the site. The torn-out sheets should be posted for regular comment to a trained archaeologist attached to some nearby institution. The field worker should retain all rights of publication, with the proviso that, if quotation or citation is made in any published work, his field work will be duly recognised. He

is entitled to expect help from the professional worker, and in return should reasonably acknowledge the help he has received. It is courteous too, to offer a representative series of implements and finds to the public institution that the professional represents. The use of a carbon notebook permits easy reference to page and line in carrying on correspondence.

Open-air Sites

Every open-air site presents its own peculiar problems. It is quite evident that this is the commonest type of site to be found. It is evident too that, owing to varying conditions, objects of widely different ages may be found together on the surface of the soil. For this reason the open site has often been mistrusted as unscientific and incapable of yielding evidence of any value. It is evident too that there are no sites which have been made to yield a tithe of the evidence that they have contained. Any site may be made to yield important corroborative evidence, and most sites will give independent indisputable evidence if properly worked over a period of years. Stratified deposits are relatively rare and of extreme value, they are protected by law, and need far more careful and concentrated study. That is a field for organised excavation on rare occasions, but for every cave deposit excavated it should be essential to draw corroborative evidence from a series of surrounding open-air sites. A cave deposit should be digested for a period of years before an excavator is permitted to turn to another cave-deposit in the same area. The relationship of cave to cave, and of each to the material found in the open air is going to become a far more important part of prehistory as virgin sites become scarcer. This is referred to again under the Survey (Chap. XIII).

We should endeavour to learn from surface sites all that the site will yield, without any predisposed theories, and with a detailed knowledge of what work has been done in the general neighbourhood by previous workers. This means reading, the detailed study of previous collections, and the complete assimilation of local conditions. The bulk of prehistoric material has never been published, and the present tendency to rush into print before material has been assimilated and digested is very dangerous indeed without being in the least helpful. (Chap. XIV.)

In general there are two types of open-air site: deposits made by man and left undisturbed, and deposits made by man but subsequently redistributed by natural agencies. The latter tend to be the older and are found on the talus slopes of hills, lying on river banks on terraces, in gravels, or related to lake shores or sea beaches. They are becoming part of the geological story of the country, and by reason of age the implements have usually been affected to a greater or lesser degree by factors that produce rolling, patination, oxidation, windwear, etc.

In relatively undisturbed sites we are dealing with the remains of camps, villages, quarries or workshop sites. The first two are related to easily accessible water or shelter, or to protected valleys, while the last two are related to natural outcrops of rock suitable for implement making. There are several differences between these and enclosed sites:

1. The open site is often unconfined, except perhaps in one direction by a stream, beach, or cliff, etc.
2. Surface sites are often partly cut into by erosion, and generally have been slightly disturbed by annual rain, etc.
3. Surface material is seldom stratified over underlying human material.
4. At quarry or workshop sites we cannot expect to find finished implements, such as would be typical of home-sites. Rejects, trimmings, fragments of cortex, and the usual waste of a workshop will predominate.

Quarry and Workshop

The quarry is directly related to the source of raw material. The intention was to collect a load of roughly trimmed rock, after having reduced the weight by testing for flaws, removing the rough outside cortex of the weathered rock to reveal the hard flinty core, and by a preliminary rough shaping of usable pieces. In many instances it is almost impossible to be certain what cultural group made use of a particular quarry. There is no evidence other than rough masses of rotten cortex, or crude spalls and rejected stone. Many of the recognisable tools are unusual, and may mislead one into the belief that a new and unknown culture is represented. Stones that can only be described

as hammers, wedges, levers, picks, chisels, etc. occur, and are generally shaped by intensive use. These are not typical parts of the culture as found in a home site, and many of the shapes and sizes will depend directly upon the form in which the local rock is available. No finished implements can be expected, and in some cases true cores or even recognisable rejects are absent, as these have been removed for further treatment at workshop sites. Such a site should be watched for signs as to the period or periods represented, and other sites should be watched to discover where this particular stone was eventually employed.

The workshop or factory site was generally a convenient spot where the rough quarried material could be chipped to shape. It probably depended for its origin upon the one-time presence of shade, or a good observation post for watching game. Workshops are found scattered on rocky ridges in the Karroo. Large numbers of rejected flakes, often without a single specimen with secondary working, scraps of trimmed-off cortex, redirecting flakes, "quarter-lemons" for remaking a striking platform, cores, hammer-stones, and so on, are typical. Broken tools may be found discarded on the spot and will show the culture and the standard of workmanship. But this is not necessarily true, and at one workshop site overlooking Kuurfontein farm, Vosburg, I found only many hundreds of flakes, all fresh and unpatinated, with a few worked out cores. The technique showed a very late Smithfield culture. Finished tools were located a mile or so away showing the same lack of patination and the same technique.

Quarry and workshop may often be combined, the coarse stuff being worked on the spot. Such a site, probably many miles long, was located by Dr. Rennie in the Matjesfontein district. In any case finished tools were obviously removed and used elsewhere, and are as unlikely to be found there as completed stools, chairs or tables in a carpenter's abandoned workshop.

Home Sites and Hut Settlements

In the home finished tools are to be expected, together with material that reflects the more feminine side of simple life. Thus in the more recent sites, in addition to the man's arrowpoint, we may find such things as pottery, ostrich egg shell beads,

ornaments of bone or stone, and in rare instances, fragments of wood or basketry.

The short-lived hunting shelters of crude thatch used by a people such as our Bushmen provide little of value in the way of even the simplest hut-foundations. The less nomadic Hottentots and Bantu provide more data. At Vosburg "homes" could be recognised, little depressions filled with natural soil, between the harsh dolerite boulders. In dealing with more advanced peoples the general relationship of huts, pathways, obvious sitting places, cattle-kraals, waterholes, etc. should be noted. Here aerial survey will eventually yield important evidence, once the spot has been accurately located on the ground, marked by the whitewashing of a rock etc., and photographed from less than 3,000 feet.

The presence of post-holes, or perhaps the central support of a hut, hard earth floors (*terre pisé*), stone walls or foundations, rings of stone placed to anchor a wooden hut frame, grain pits, graves, and a variety of other clues should be recognisable from photographs taken at 1,000 feet. The survey of wide plains from mountain tops has been neglected, but should yield important evidence, even if only showing the distribution of "homes" such as those found at Vosburg, or of crude and almost unrecognisable stone circles, as are found near Pniel on the Vaal, or complete domed huts such as Prof. van Riet Lowe described from Vechtkop. In all such cases a careful study of midden debris is essential, and every item of evidence that can be used should be sought.

Kitchen Middens

This term comes from the Danish, but is good North British in its adapted form. It merely means the rubbish heap of ash, bones, teeth, shells, and decayed matter that is typical of any late prehistoric site. While it has come to be applied almost exclusively to coastal sites where various peoples have taken to a strandloper mode of subsistence, it can equally reasonably be applied to any such recognisable accumulation of feeding debris.

The mass of the material of coastal middens is held together by an accumulation of vast numbers of fish-shells; it may extend for a hundred yards in length and stand ten or fifteen feet in

height, but this volume is very largely made up of shore sand anchored by the shellheap, and it is misleading to regard the mountain of shell as entirely man-made deposit. Methods that will be suggested for cave excavation must be used here, rather than those to be given for open sites. The first essential is to fix the position of the dig, and a compass direction. Often a fixed point on land or at sea, or the nearest trigonometrical beacon will supply a point of reference. A plane-table survey should be built round this, relative to a base-line, and the position of the grid marked with some accuracy on a large-scale map. As representative a collection as possible of fish-shells, bones, teeth, scales and other materials should be made for later identification at a coastal museum. It is very important to note the presence and depths of the following midden elements from surface: pottery, Neolithic elements, fishbones (in quantities sufficient to show that vertebrate fish were habitual articles of diet, and not casual drifted fish), bone tools of bird-bone, bored stones either circular or elongated. It is certain that there have been various periods of coastal midden, all within the Later Stone Age, and these elements will serve for eventual identification of the midden periods. The collection of both positive and negative evidence concerning the distribution of the elements outlined above is essential for a proper understanding of even very localised groups of midden.

Fishtraps

At various sites about our coast there are enclosures, dams or *vywers,* used as tidal fishtraps. The wall rises above low-tide, but at high-tide it permits vertebrate fish to swim in. As the tide recedes they are trapped. The presence and pattern of these should be noted and described, and neighbouring middens searched to find at what period the consistent eating of vertebrate fish began. In some cases these fishtraps are still in use, probably by the descendants of the original builders.

Approaching the Open Site

As sites of this sort are seldom confined, the only approach is by means of a "grid" marked on a large-scale map, and further enlarged as a site map. (Fig. V.). The grid should allow further

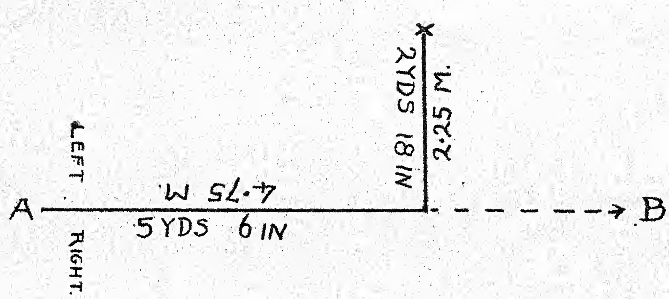

Fig. V.
The grid method applied to an open site.

extensions in three directions, and be related to a fixed point and a compass direction, which together form the base-line. If possible, fix the direction in relation to a landmark recognisable both on the district map and on the spot.

Taking the fixed point A, off the site, and plotting the direction by simple plane-table methods, measure off a base-line across the centre of the site, calling the line of direction B. Mark it with pegs, skewers, tenpenny nails or some reasonably permanent means. This distance should be marked off in yards or metres, which may also be pegged. The location of any implement, hut-site, grave, etc., is fixed in exact relationship to the point A, and the direction B. First take the distance along AB (8′3″). Next give the bearing (Left or Right) from the base-line, and finally measure the distance at right angles from AB (6′4″). If a complete pot is found at this point, it would be marked 8′3″ L 6′4″. In metres this would approximate to 2·48 L 1·94. In the case of a hut, grave or scatter of pottery, or a home, always refer to the centre of the recognisable distribution, and give the approximate or exact radius of the distribution from that point. Thus if a heap of potsherds were all that remained of our pot, this can be placed together in a single bag, marked with the centre of the scatter, and with the radius 10 feet, (or 3·2 metres) added.

Each site has its own peculiarities, and though it may seldom be necessary to collect a site so that the position of every find is known exactly, it is essential to get this degree of accuracy in the first place, in order to discover what deductions can be drawn

from distribution. The most important type of evidence is proof of differential distribution of cultures. Even if two distinct cultures are found on the same site, the chances are very much against their having an identical dispersal over that site. (Chap. I.) In certain instances even greater precision may be needed to deal with the distribution of implements in relation to a hut floor. In such a case, draw a plan of the hut floor, rule off a grid, and mark each find with its grid number. (Chap. IX.)

If a whole village is found, or a native hamlet, the orientation of each hut, their distances apart, the position of the cattle kraal, the presence of stamped earth, etc., should be measured and mapped. The centre of each hut is the point to note, then the radius. Place an upright stick at each hut centre, and sight the alidade on this from a suitable base-line. The hut itself is drawn in with a compass to scale. The simplest scales are generally those that are on a 1/1 basis: 1 ft. or 1 yard to 1 in. or 1 metre to 1 cm. etc.

Zoning

Simple statistical methods should be applied critically to the implement types found. A large number of specimens must be collected without prejudiced selection. It is wise to collect everything and note the position to within a square yard or metre. It is essential to take the material home, examine it carefully, and divide each square yard into two groups, first choice and debris. The secondarily worked specimens must be individually marked, the remainder can be put away in boxes bearing the same mark, with the word, debris or debitage. This permits of later reference.

This system can now be extended to form a locality survey. If the area is rich, take a second test from a site, then a third and a fourth. It should be obvious that if each site yields a comparable series of implements, techniques and associations, we are dealing with a single culture. If however half the sites show a single culture, while the other half yield consistent additional elements, then we are dealing with two or more cultures at these latter sites. By subtraction or elimination we can deduce the second, and perhaps a third culture. This can be done on any series of open air sites, and very often yields results. We are now in a position to define these cultures, and

further work can be undertaken on implement types, technological elements, etc., on each site in the light of our newly acquired knowledge (Chap. I.). I use a simple table of lines and columns to analyse the elements isolated. It is of course essential that comprehensive and unselected collections be made from each site. The final step is the reapplication of our knowledge to new and virgin sites to see whether our cultures will stand the test. (Turn back to Chap. I. for an example.)

The above outlines shortly the method by which I worked out the cultural groups in South African prehistory during 1924 and 1925, and finally submitted my conclusions to a meeting of amateur prehistorians in 1926 as a working hypothesis. The fundamentals suggested then have withstood the test of twenty years. The entire collection at the South African Museum was first worked through, and primary deductions made. The results were reapplied at the McGregor Museum, Kimberley, and at the Albany Museum, Grahamstown. They were also tried out at well over a hundred sites (many of them my own,) in the Cape of Good Hope, Griqualand West, the southern Kalahari, South-west Africa, and the Cape Peninsula where Colonel W. E. Hardy's collection proved invaluable. The cultures yielded well to this method, except those of the Middle Stone Age, with which I had to deal similarly at a later date. In 1925 the theoretical grouping thus obtained for the Cape was further extended by C. van Riet Lowe to include his extremely rich Free State sites and was found to accord well with the Fauresmith and Smithfield material there.

Physical Condition

By *état physique* is meant the state of an implement that has been subjected to natural agencies producing rolling, wind-wear, patination, oxidation, etc. This is sometimes brought forward as a simple test of the relative age of implements, the reasoning being that material lying exposed to such agencies for a long period will be more deeply affected than material so exposed for a shorter time. These processes are functions not only of time, but also of the intensity of exposure and the chances of protection. An implement protected against these agencies will escape unscathed, while others a few feet away may be open

to intensive action and be more heavily affected. Cases can everywhere be observed in which half a broken implement is deeply patinated or weatherworn while the other half is less or differently affected, or even quite untouched.

Kaiser, in his *Chemie der Erde* (Vol. iv, p. 29, 1929) uses the term *epidaphic* to describe those changes in stone that are a product of contact with soil. I have already given some account of these processes as they occur at Vosburg, and any interested student may look into the processes there. According to Kaiser the processes include the leaching out of soluble salts, the absorption of gases, especially to form oxides of iron etc., the exudation of crystals of gypsum, magnesium and potassium chlorides, etc. These epidaphic effects will be most intense in the presence of standing moisture, muds, mosses, and in open pans. An implement situated a foot above normal pan-level will escape the intensive action of the soil chemicals, while a stone three feet lower down will come under their influence very markedly.

While this is proof that physical condition is not in itself a criterion of relative age, simple statistical methods may be applied here to augment the evidence of single instances. We employ the method of elimination described above. Given similar materials and general conditions, if it can be shown that an identifiable cultural group X. shows a deeply affected physical condition, while a group Y. shows relatively slight alteration, and cultural group Z. is quite unaffected, then we may take it that these cultural groups occur in the order X-Y-Z.

In employing this method the following points must be noted:

a. The need for large numbers of unselected specimens.

b. Recognisable morphological and technological differences between groups.

c. Comparability of the types of material and the conditions of exposure.

d. Final recognition of differences of physical condition, coinciding with the recognised cultural groups to a degree that eliminates chance.

e. The acceptance of intermediate groups, consisting of artefacts that have come under more or less intensive epidaphic and other actions than the normal members of their cultural group.

Do not make the fundamental mistake of dividing implements into patination groups and then attempting to deduce cultural grouping. First apply the cultural tests outlined earlier, then deal with the question of relative patination or physical condition. As in all statistical method, large numbers of cases considerably increase the value of the deductions. The number of instances considered should be cited, and the term *per cent* only used where well over a hundred examples are studied.

Here again the discoveries made at one site should be extended to cover other local sites. This is the local survey technique, and new facts should certainly be deduced from this reapplication. It is only in such cases that we can hope to formulate a general ruling, applicable to our own area.

Constantly remember that you are collecting facts, and that your finds should merely serve to illustrate your facts. Negative evidence is as important as positive in any science.

Double Patination

While physical condition must be used carefully, double patination (that is to say, where flake scars show that the same implement has been flaked twice, so that the old flake surfaces are patinated while the new are quite clear or less patinated) is a certain guide to the presence of two periods in the history of the specimen. Similarly, it may be added, a wind or water-worn specimen retrieved from a cave deposit in which all other specimens are sharp and clean, indicates with certainty that the implement belongs to an older period, and was picked up and brought to the cave as a curiosity.

Having generalised our methods, and applied them to open sites and to middens, we can turn to the more difficult and important field of the enclosed cave or shelter site.

IX.

EXCAVATION

A little grave, a little little grave, an obscure grave.
Rich. II. III. iii.

Cave Sites and Shelters

Cave sites are more apparent than open-air sites, and are therefore more vulnerable to casual fiddling. They are confined in more than one direction by surrounding rocks, and the deposit is to some extent protected from wind and rain. Stratification is commonly present, and is in general vertical, consisting of more or less horizontal layers falling to a talus at the mouth of the shelter. The difference between a cave and a shelter is generally a difference of the degree of enclosure; a cave being protected on three sides, a shelter on one or two. A cave is more deeply cut into the rock and the deposit is therefore more efficiently protected.

In such a site refuse accumulates — wind-blown dust, leaves, bat and swallow guano, scalings from the cave roof, and so on, — all from purely natural sources. The accumulation is relatively constant. In addition, if man makes use of the shelter, he brings in branches, mud, ash, bones from feasts, implements, shell-fish, vertebrate fish refuse, sea-weeds, bedding material, and other decaying vegetable and animal tissues. The deposit thus accumulates faster when man uses the cave, and it is left protected and relatively undisturbed, and through being trodden down tends to form a compact sheet or layer of deposit. The earliest layer lies at the base, and subsequent layers will lie one above the other in order, to form an automatically chronological series. The latest stratum at any time will form the existing floor.

When man leaves the shelter natural accumulation will continue and will deposit what is known as a "sterile" layer (uninhabited). This forms a natural and important seal cutting off one inhabited layer from the next. Anything found above

or below it is definitely dated in relation to a longer or shorter period of natural accumulation, if the seal is unbroken. The general passage of time can be gauged from the relative thickness of the sterile layer. Sometimes (as at Oakhurst and at a nearby site), a major forest fire will yield a sterile layer of accumulated ash, providing a means of comparing two deposits relative to a date. Such a dating line will prove extremely important in local surveys if it is watched for by future workers in the light of published material.

It should be obvious that accumulation yields stratification, and that stratification can be read as chronological order. We can thus deduce the sequence of the types of implement used, the pattern of each culture, and the types of man associable, by means of an approach that reads off the accumulated layers of material. This approach we call scientific excavation and the technique can be likened to the reading of a book, page by page, in contrast to the habits of the book-worm, which bores little holes through the pages, stealing a letter here and there.

The sequence so obtained may merely represent a series of families with a slightly developing pattern of culture, or it may represent habitation in series or in alternation, of two or more distinctive cultural groups, races of man, or even species. Here it might be observed that the earliest types of man (except in the Montagu Cave) seem to have avoided caves, and it is only relatively late in man's story that shelters were habitually used. This is true too of Europe where the Lower Palaeolithic is essentially associated with gravels, the Middle Palaeolithic with both caves and gravels, and the Upper Palaeolithic with caves, shelters, and a few open-air sites.

Approaching a Cave Site

If a cave-deposit is to be excavated we must first examine the surroundings, note where water was obtained, the easiest route to the shore or towards open country. Along these paths may often be found excellent specimens showing what cultural elements are to be expected in the deposit. Paintings should be carefully sought, not only in the shelter, but on surrounding rocks.

It is next necessary to gauge the area and depth of the deposit. The limits are clearly defined by the cave walls, but at the forward or open edge the material of the deposit will often tend to overflow and fall sharply to form a talus deposit, sloping steeply from the existing floor to the slope of the valley outside. This is generally delimited by a "drip-line" at its crest, marking the limit of protection against light rainfall, and behind this drip-line the deposit will be relatively dry. This line marks the true forward extension of undisturbed deposit. In front of this implements will be found trodden down by climbing feet, and much of the lighter deposit will have been washed away by rain, destroying organic tissue, and washing the implements.

In addition to the drip-line, the strike of the rains should be noted. This consists roughly of an angle from the perpendicular of 30° measured from the lip of the cave roof. The area behind this represents the part of the cave that had complete protection at any period in its history. Now this area varies through the history of the shelter. We can compare the Oakhurst shelter and the Forest Hall cave to see what effects this may have on the contained deposits. (Fig. VI.)

Oakhurst. The shelter originally consisted of a wide open " (" facing roughly east. The rain-strike covered the whole of the original floor from drip-line to cave rear, and this continued until half the height had been filled in by runnels, windblown sand, a few casual hearths, leaves, and natural accumulations of that sort. There thus came a period when the rear of the shelter provided complete protection in Smithfield B times. From now on the shelter was consistently used, and provided better and better shelter as the floor level rose. The limit would be reached when the distance between roof and floor became too small to permit the inhabitants to sit there comfortably.

Forest Hall, Plettenburg Bay. This cave was apparently cut at the time of the twenty-foot raised beach (Middle Stone Age), either by the sea, or by the neighbouring stream. The ceiling consists of a series of inverted steps that cut deeply into the rock. The angle of the rain-strike left an area of adequate protection within the cave at all periods of its history. Once the new cave had dried out, and there was no further fear of

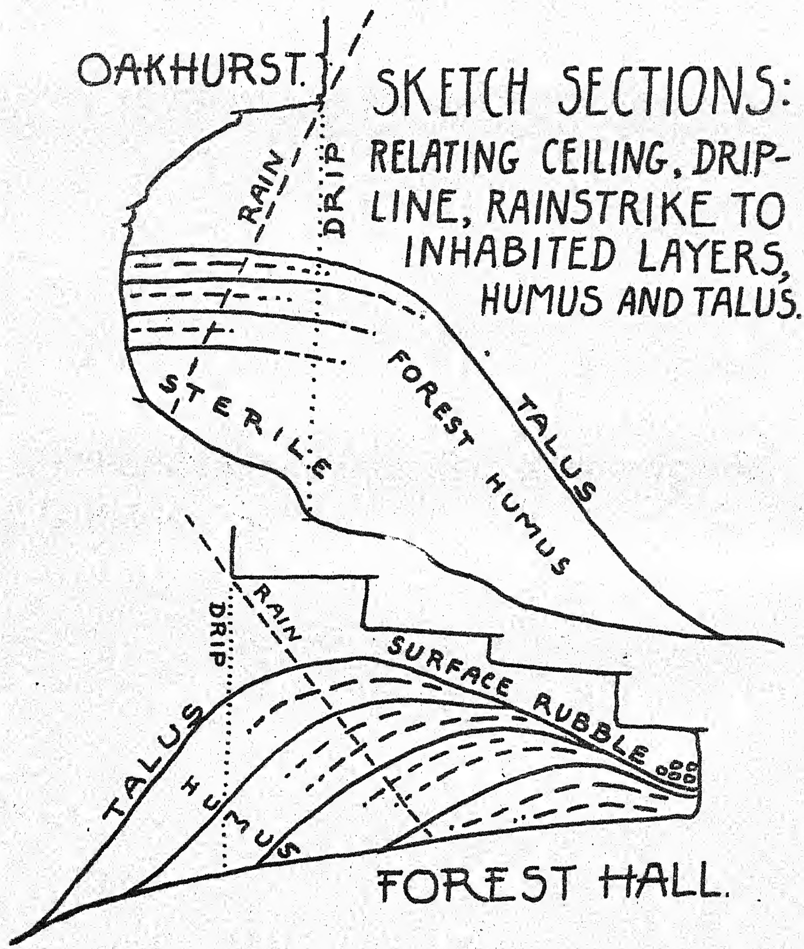

Fig. VI.
The relation of cave deposits to rock formation and to weather.

flooding, man came in and lived at the rear of the cave. As the floor rose and rose so he was forced to come forward step by step; until by the end of his sojourn he lived in a little shelter a few feet high, many feet above stream level, apparently ignorant of the huge filled-in cave lying below and behind him. At the back of the cave, between the rear wall and the deposit was an after-talus, running down the slope parallel to the surface of the deposit. This consisted of large stones, big bones of animals, etc., not trodden down, but forming a loose rubble, and leading to the dark corner of the porcupine den.

Similar deductions can be made at Klip Kop cave, Hermanus, which was analogous with Forest Hall, and at other sites. The rain-strike is therefore important in assessing the way in which the strata will lie. At Oakhurst the tendency was for an accumulation to form against the cave rear, protected from the rain. At Forest Hall the deposit moved further and further forward towards the light, always tending to approach the limits of protection.

The talus slope provides the best clue to cave content, and once a permit has been obtained a test should first be made here, if it is at all possible. A narrow test-trench should be started low down in the talus outside the drip-line and brought towards the cave. Avoid proximity to large trees, as these tend to disturb the deposit with their roots. Once a clean section on either side is exposed, make a study of stratification. This will lie at an angle, roughly grading with the surface of the talus. Working from surface widen the trench to a yard (or a metre) in four-inch layers (10 cms.), following the slope of the deposit. Make a careful examination of the material so obtained, and try to analyse the fundamental strata of the deposit. Keep material from each set of strata in a separate collecting bag, and take it home for re-examination. The whole test-trench must be dug in such a way as to conform to the "grid" used in planning the excavation.

I differentiate between a layer and a stratum here. By a layer I mean a parallel sheet of material, of definite thickness, as excavated in a trial dig. By a stratum I mean roughly parallel sheets of occupational deposit of varying thickness, as left by

primitive man. While many changes of colour are to be observed, making the sequence of stratification clear, these do not necessarily coincide with cultural changes, which may be quite independent. Nor will a stratum necessarily cover the whole floor; it more often tends to fill little depressions left in the surface of the cave floor at the time. During a heavy spell of rain a heap may accumulate well behind the rain-strike; and during a particularly dry time the inhabitants may prefer to sit and live in the sunshine near the cave mouth. All this must be watched for in making any assessment of stratification.

Elsewhere (Chap. XV) a list of tools and equipment suitable to the prehistorian has been given. Others will suggest themselves as work proceeds. Read through the list with a view to understanding the detail that follows here.

If any excavation work is to be carried out, prior permission to excavate must be obtained from the National Monuments Commission, and plans made as to how work can best be carried on. The permission of the owner of the farm must be obtained to camp, use water, and to excavate. It is wise to offer the farmer the sifted soil as fertiliser. It has little real value, and much better results can generally be obtained by using a leaf-manure compost with added lime salts, but unhappily farmers still have a great belief in "cave guano" of which there is a minute quantity in any cave deposit built up by man. The best results from cave soil are obtained by planting leguminous crops with a view to introducing nitrogen to release lime in a form assimilable to plants. Analysis of cave soil should be made before it is added to fields. Many gardens at Mossel Bay and elsewhere have been ruined by sea-salt accumulating in caves well above present sea-level. Potassium chloride is useful, and forms a large part of the cave soil, but it is more easily obtained from the ash of maize-stalks, firewood and grass.

Excavating

Remember that the cave is to be scientifically excavated, and it will be necessary to camp on the site for a month or more at a time. In Europe the "season" generally coincides with the Long Vacation, or that part of it after crops have been harvested.

There a return is made again and again over a period of years to the same site. This in a country where work is done by European workmen under supervision, or by partly trained students looking for a cheap and healthy vacation, again under supervision. It has been found that two or three regular workmen and a casual hand are the largest number that can be adequately controlled, while half-a-dozen students is the maximum that can be organised for supervision. Every item must be under supervision, and in Africa two natives, a student, and one trained excavator is the most that can be used on any one trench or section, digging and sieving. Every spadeful must pass over at least two sieves, under the eye of the expert, who will find all his time occupied by sorting, making sections, watching excavation, etc.

The 1″ sieve should remove heavy stones and shells before they can pass to underlying sieves. It must be searched for flake-tools, cores, grinders, bored stones, etc., that have been missed *in situ*. Below this sieve is placed either the 9 or 4 holes per sq. inch riddle, depending on the deposit. Under this is the 36 holes per sq. inch sieve for most Later Stone Age deposits, and a test must be taken frequently with this in Middle Stone Age deposits. Beads, of ostrich egg or porcelain, small bead borers, etc., should be watched for.

Work clean, and always brush each vertical section and sweep the floor of the dig, before each photograph, and before closing down for the day. The deposit is worked from surface downwards, stratum by stratum, in yard squares. If no stratification can be determined, start by working in 2″ to 4″ layers (depending on the richness of the deposit) until stratification can be determined, then work to that. Remember to check stratification at least once in each square yard of superficies.

The Grid (Fig. VII)

Work must be carried out in grid form, which should accommodate itself to any trial trench previously dug for the purpose of assessing the cave deposit. A plan of the cave floor is made and marked in squares, each representing a square yard or metre. Each column of squares is now lettered with a capital. Each line of squares is lettered with a small letter. Lettering should be from the front of the cave back, and from one side to

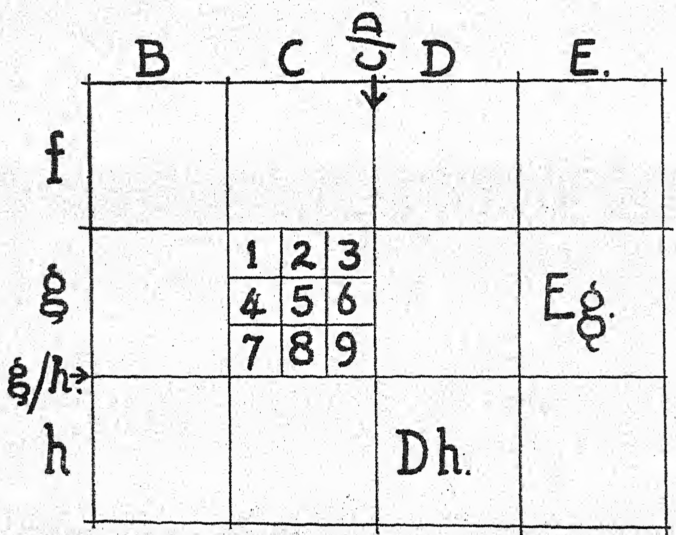

Fig. VII.
The grid as applied to an enclosed site.

the other, and quite independent of what it is intended to work. If necessary the numbers 1-9 can be added, each representing a square foot within the square yard. These numbers should read from left to right to agree with the direction of the capitals used for columns. An implement, bag, grave, etc., marked Bg will lie in the square that marks the intersection of column B, line g, of squares (second column, seventh line). Bg1 material may lie four feet away from the diagonally opposite Bg9, and have a different history. If preferred the military decimal system may be used to denote exact points within each grid square, but this degree of accuracy is not needed. Whichever method is used, be consistent.

Depth

One great difficulty is to express the varying depths and thicknesses of recognised strata at different points. Care is needed to make the lie and position of each stratum intelligible after a dig. If floor and strata are either level, or lie on a single slightly tilted plane, it is easy, as depth from surface gives all that is essential. In most deposits strata do not lie so conformably, and some other method is needed.

Imagine a plane overlying the surface of the deposit, just clearing its highest point, and level in all directions. This is marked in paint on the wall, and the surface of the existing floor is similarly marked. The horizontal plane we can refer to as the PR or plane of reference. On your grid mark the depth of the floor surface below PR. From now on, give all depths as from PR, or from surface, as you prefer, but systematically. Always give the grid number of the point at which depth is taken. Thus if we wish to fix the position of a dark sandy layer below a level floor or below a level PR:

Bg5 3′6″ to 4′1″	Bh5 3′9″ to 4′4″	Bi5 4′1″ to 4′8″
Cg5 3′8″ to 4′2″	Ch5 3′11″ to 4′7″	Ci5 4′3″ to 5′0″
Dg5 3′10″ to 4′3″	Dh5 4′2″ to 4′7″	Di5 4′6″ to 5′2″

The figure 5 is constant, as it refers to the central square foot of each superficial yard of grid. This can now be reproduced as a series of sectional drawings, B, C, and D, and g, h, i, which can be finally converted into a perspective three dimensional section and plan. The six sections should be reconstructed into an "egg-box" grid of interlocking cardboard strips. Try this as an exercise from the figures given; now repeat the exercise, presuming that the sloping floor at each point is below the PR by:

Bg5 0″	Bh5 6″	Bi5 12″
Cg5 6″	Ch5 9″	Ci5 15″
Dg5 12″	Dh5 15″	Ci5 24″

These exercises should be done on a graph paper, or squared paper, on a scale of an inch to a foot. Don't worry about the perspective drawing unless you understand the principles involved.

Upright laths (1″ x 1″) may be kept permanently in position at fixed points to mark the intersection of grid lines, the height of the PR, and the height of the floor surface as the deposit is dug away. If this is impracticable, cut the laths to the exact length, paint them matt-white, dry them away from cave dust, and mark them with the positions they refer to. They can now be marked with the depths of each recognised stratum, and the section representing the depth from PR to floor can be painted black. If the stick is held upright in correct position when new depths are taken, or when photographing, it will simplify reconstruction.

A simple home-made sliding level is essential to get accuracy. It consists of a string, which can be stretched either to grade with the floor level or with the PR. On this is suspended an elongated wooden cross, supported from staples or screw-eyes at the ends of the two longer arms, and sighted through screw eyes at the extremes of the two shorter arms. This can be brought to bear on the PR or the cave floor, as marked on the cave wall, and heights taken from there. The string should be held taught when sighting, and must not be suspended permanently, as it will interfere with work. (See illustration in Chap. XIV.)

The fundamental points about various methods of taking depth are that they should suit the deposit, and be of a type that can be reproduced as a three dimensional section, and make the stratigraphical source of each implement, etc., clear. Whatever system is used must be planned beforehand, and adhered to strictly.

Marking and Packing

Mark specimens immediately, or better, place them into marked calico collecting bags, with a detailed label inside. Avoid indelible pencil, as it runs in rain. The material should be taken to camp for sorting, and only complete rubbish should be discarded at the site, such as rock-fallings, etc. A day or two of digging will teach the excavator what to discard, but error should be on the side of overcollection. Pack trimmed and well-made implements separately and mark them as "worked". The remainder can be marked "debris". Dry organic material out of the sunlight before packing. I have found that a copper-wire fly-mesh sieve, placed upside down is best for sorting, as dust falls through. If soil samples are to be taken, take them from this dust, stratum by stratum.

Enough newspaper and packing should be available to ensure against implements rubbing or chipping. Pots, skeletons, ivory, and other fragile material should be carefully packed in individual boxes. In some instances impregnation with an understood preservative, wrapping in cloth strips, etc., will help. Delicate objects should be placed in the centre of the car when travelling to avoid vibration. If they are to be sent by train, pack them well and in a strong container. Double-check labelling in every bag and

box, as it is irritating to find two or three without reference to their depth or position.

Photography

Photographs should constantly be taken. Two cameras are useful, a miniature for taking serial photographs from a fixed tripod and a larger camera for special photographs. Surface level is the best height for serial sectional photographs, and slight allowance may be made for changes in focal length as the section recedes from the camera. Recognisable spots on the cave wall should be included for reference, and a yard stick or other clearly printed scale included with each photograph. A dozen photographs should be taken for each one that will eventually be published. In leaving a fixed camera, see that it is very heavily protected against dust, as cave siftings are capable of creeping into the mechanism, and will affect both shutter and lens.

Notes, sections, (and if convenient, photographs), should be collated from time to time, if possible daily, but certainly every week-end. This allows for planned excavation and acts as a constant check, and a gauge of the needs of the next section to be tackled.

In general, a deposit that has awaited the prehistorian for a thousand years or more, is worthy of the most careful and expert craftsmanship that you can give it. Remember that in turning back the pages of history you are destroying the evidence of each leaf. Every accurate conclusion and every scrap of available evidence should be transcribed from each page of the deposit in the form of notes and sections, and the material so obtained should be preserved.

The Archaeological Survey, or a museum, may ask for a "representative collection". If you have been favoured with constant help or advice from a particular institution, or if you have a feeling of loyalty to a University or Museum, it is incumbent upon you to provide them with a representative series. There are two ways of doing this, either a series can be sorted out after the end of the dig; or else the more generous gesture of all material from a complete grid-square may be made. This ensures that the collection is not unreasonably broken up, and leaves the chances of good or bad "finds" to the site itself. If you

have no reasonable hope of housing the series at home, present it all to a museum in the general vicinity of the site.

Graves

In excavating a grave three sources of evidence are sought. The complete skeleton; the general association of implements with racial types; and the particular arrangement of the skeleton and associated material as evidence of funerary rites. These three sources are additional to questions of chronology and stratigraphy that arise in relation to any find.

If burial takes place into any stratified deposit, the body will be buried from the existing surface into the geological past, that is to say, as an intrusion. A grave thus belongs to the date of the grave mouth, and not to the deposit in which the bones happen to lie. It is therefore essential to locate the position of the grave mouth accurately. In addition the earth thrown back into the grave has been dug from the surface to the bottom of the grave, and will consist of a jumble of material covering the depths represented by the strata cut into by the grave. There are thus false associations that must be guarded against.

Directly any signs of burial are observed, either in a section or through the discovery of heaped stones, work should be stopped and plans made to deal with the intrusion. The stones should be carefully cleared and brushed, and the date of the adjacent layers fixed, if necessary by local testing. The stones should be carefully turned over with an excavator's hook to see if there are signs of paintings on the under face, and to make sure that they are gravestones. A clean vertical face should be cut to discover the extent and content of the grave-infilling and the position and relation of immediately adjacent unbroken strata should be noted. The infilling should now be excavated, sieved and marked as infilling, with a grave number. As stratigraphical evidence it is generally useless.

Care should be taken to note whether the body has been deeply buried, whether the stones are at the mouth of the grave, or whether they immediately overlie the skeleton. The skeleton and immediately surrounding earth should be dealt with most carefully. A whitewash brush, dustpan and builder's trowel are the only implements that should be used, and only one person

should work on the skeleton at a time. Slow work helps to dry out the bones evenly, thus strengthening them. Every dustpanful of earth should be passed over the finest sieve, and careful watch should be kept for bracelets of beads or ornaments in position on neck, wrist, arm, calf or waist of the skeleton. If found in position they may be silicated, or cemented with beeswax in turpentine for careful study later. The string holding the beads in place will certainly have deteriorated. Careful watch must be kept for ostrich eggshells, remains of hide, basketry, ivory weapons, etc., in the grave. Do not presume that because an implement is found in a grave that it is associable; infilling will distribute itself in a haphazard manner, and something is sure to be found in the neighbourhood of the hand. Keep a careful look-out for ochre on the bones or scattered in the surrounding soil. Proper excavation can be expected to take eight to ten hours of concentrated work.

Never undercut long bones until their ends are completely free, never use them as a fulcrum for even slight leverage. Excavate with the hands alone, or use the tip of the trowel and the brush. Excavate the hands and feet carefully with the brush and dustpan, and observe what is found in the palm of the hand. The bones of each hand and of each foot should be packed separately in small collecting bags marked "left hand", "right foot", etc. All small loose bones, such as the patella, should be placed in a fifth bag, and all five should be marked to correspond with the number of the grave, for which I use Roman figures. The whole should be packed together in a single case. A petrol or paraffin box does admirably, as it easily contains a skeleton with paper packing.

The excavation of the Oakhurst shelter was given in some detail to yield some clue as to method. Useful hints can be obtained from the *Manuel des Recherches préhistoriques*.

Photographs from the fixed tripod and with a photographic mirror, should be taken constantly, especially when anything of interest is found, and when the skeleton is laid bare and complete. Note should be taken of depth (I use the highest point of the skull as a fixed point), orientation, position and any other points of interest. Care should be taken to notice whether subsequent graves have been dug through the one excavated, or whether the

grave overlies one immediately underneath. These tend to upset the deposit, and make it more difficult to assess exact age. Unhappily they are very common in South Africa.

Midden sites in the open air should be excavated in the manner outlined here, but it must be remembered that we are generally dealing with somewhat awkward stratification, as the midden heap is similar to a talus slope rather than to a horizontal cave deposit. Sections here need have no relation to the surface, and strata have to be carefully followed in order to obtain any sequence.

Stepping a Deposit

In all excavation it is important to keep a clean section on each side of the trench, and at the end. If the dig is deep, break the section by stepping back the deposit to prevent collapse. A shelf of earth at an exact depth, and a foot or eighteen inches wide should be left here and there. I find that fine, dusty deposit will support one or at most two feet of almost perpendicular height. Earthy deposits will hold two or three feet, while hard compacted deposit with some cementing element in it, will hold four to six feet comfortably. Never use the shelves so left as steps unless there is no other means of access. They are there to prevent collapse and to leave a straight edge at the lip and a clean section to the dig, not for climbing about. If inquisitive visitors are expected, fence off the top of the steps lightly, and force them to come down to the bottom of the dig by an easier path. Interference by outsiders should be avoided, and the less publicity is given to excavation while it is in progress the better. If material falls in from the vertical face, discard it unless its origin can be located.

A trench six feet wide at surface, stepped back one foot in every three will yield a two-foot trench at nine feet. This is the minimum width that can be dug comfortably. If the deposit is to be worked further, the whole trench must be widened. Start at surface, and increase the width there by two to four feet, and carry the section down to the nine-foot level. Work may now be continued for a further depth of three to six feet. This new cut should be made to constitute a test of the previous work, and should be kept separate. The material so obtained can be

presented *in toto* to the Archaeological Survey or preferably to the nearest museum, after it has been written up.

Leaving a Deposit

When a deposit is finally left certain things should be remembered. A single trench will tell all that a cave has to yield in the way of stratigraphy, and excavation should never be allowed to disturb or interfere with those parts of the deposit that are not being scientifically excavated. This means that all sifted material should be removed from the shelter. At least two-thirds of the total volume of the deposit (as estimated by examination before work commences) must be left quite undisturbed, and should not be touched for ten or twenty years, when it is to be hoped that our funds and scientific methods will have so far improved that a more detailed check can be made. Even then only a cut one or two feet wide need be made, to the total depth of the deposit. The deposit should therefore be protected as far as possibe. It may be revetted with river stones, wire-netting or even brick (if it is important), but some sort of fence should be placed across the edge of the deposit to prevent men and animals from falling in and breaking the edges of the sections. Divert all possible runnels and streams that may pass through or into the shelter during the rainy season. This can be done by digging a trench across the runnel at an angle, and facing this with stones, so that the water is not dammed up.

Soil Samples and Pollen Analysis

There are two ways of collecting soil samples. A test-tube can be carefully pressed into the deposit, and removed with a local sample, marked with the stratum, depth, etc. This is apt to give an overlocalised sample, perhaps representing a hearth, a grave, or a patch of bedding. The second method I find preferable. When implements are finally sorted over the inverted fly-mesh sieve, a clean sheet of paper is placed underneath, and the dust, representative of the whole stratum is collected there. This is similarly placed in a test tube and marked. The paper must be carefully brushed free of all dust before implements from a second stratum are sorted and cleaned.

If a pollen analysis should be attempted, there are two important sources of error. Any tree growing in a cave deposit or talus will cast its pollen in a wide cone, including the cave floor. In a country of mixed forests this will necessarily mean that the trees closest to the cave will be represented out of all proportion to any others. The question of bedding is also important as shrubs and bushes of a springy type were collected and used both for bedding the living, and also the dead. At Oakhurst I found large quantities of Zostera so used; in various shelters and caves towards Cape Point I have found masses of local shrubs, of a type still used by campers and fishers at these sites. These may also negative any results obtained from pollen analysis.

In general I am of opinion that consistent analyses of the inorganic chemistry of our cave soils will eventually yield us something, but I do not yet know what. It may be relatable to climate, but the frequent redistribution of soluble salts in cave deposits may negative this. I would suggest that analyses be kept, and finally submitted to a competent chemist and amateur prehistorian as material for a wide comparative survey when sufficient data in a variety of climatic areas becomes available.

X.

> Read the book of Fate
> And see the revolution of the times
> Make mountains level, and the continent,
> Weary of solid firmness, melt itself
> Into the sea.
>
> II. *Henry* IV. III. i.

GEOLOGICAL RECORDS*

Apart from cave sites, nearly all stratified deposits are chance discoveries, resulting from the actions of unskilled workmen, digging borrow-pits, quarries, canals, ditches and sandpits. In this and other countries these have provided invaluable evidence. In the Congo most of Dr. F. Cabu's excellent data has been obtained from his careful and painstaking examination of a canal section. In France and Belgium such workers as Boucher de Perthes, Commont, Breuil and others have depended almost entirely upon the chances of the gravel pit. An intellectual class, such as that which produced Alfred Brown of Aliwal North, Kannemeyer of Smithfield, Schonland of Grahamstown and the almost legendary Dr. Atherstone, men who all made intelligent use of their leisure, is needed for the growth of our knowledge of prehistory. There is enormous scope for the amateur here. If it were possible, every roadside excavation should be constantly watched by a network of enthusiastic magistrates, schoolmasters, retired men, engineers and the like. As it is, the chances against the discovery, appreciation and preservation of prehistoric and geological records make such finds rare in a new country.

These sites are not generally protected by law, and constant return should be made as excavation progresses. Most quarry owners will welcome the interest their work evokes. Brickfields, related to terraces and river gravels at varying heights above rivers, are an excellent source of material. Specimens should be marked, note taken of exposed sections of the pit, and the

* For illustrations to this chapter, see section F in the Bibliography.

conditions of discovery, and some attempt made to evaluate the local geology in relation to river development and any Quaternary deposits.

River development

The rate of valley cutting is fairly constant in the history of any river, provided that the level of the river mouth remains unchanged. Slow-running or still water deposits a portion of any sediments it may carry in the form of mud, sand and fine gravel. Conversely, swiftly flowing water will cut through any underlying material which forms its bed, in an attempt to reach the theoretical equilibrium of profile, or base-level. Such a level can never be reached in fact, for after a certain stage further erosion virtually ceases. This process of scouring out a deeper bed and of redepositing the burden of soil and stone as the stream slows down, is called cutting and building, or degradation and aggradation. These represent the two actions that determine river history. In the upland stretches, where flow is swift and turbulent from the mountains, the channel is cut deeply and swiftly. In the flat coastal phase of the river, or behind rocky barriers in the course of the stream, the flow is slowed down, precipitation takes place, and a new, wide valley bottom will be built up, often with a meandering or even serpentine stream flowing sluggishly through it. On the stretches between these two extreme phases the action will be slighter, often depending on annual rainfall increases for cutting power, and starting a phase of building as the rains decrease.

Change of flow (and hence of degradation and aggradation), is affected very markedly by changes of precipitation, by changes in the level of the river mouth in relation to sea-level, or by major changes along the course of the stream due to the breaking of natural dams and barriers. Flow may increase yearly as a result of annual rainfall variations, or of the melting of snows; periodically, through increased rainfall over a period, or the melting of an unusual accumulation of snow, or the abnormal speed of melting of the usual snow deposit, due to increased summer heat; accidentally, owing to changes in land-levels, the breaking through of barriers to flow, or the drainage of marshes and natural dams, the mingling of streams once separate, the capture of headwaters

from one drainage area to another, the tilting of land surfaces, and so on. Conversely, flow will decrease as a result of drought or aridity, the locking up of glacial snows in a hard winter, the losing of water to other streams, the creating of barriers to flow, the tilting of valleys, etc.

Certain factors work in with one another; thus an increase of rainfall may lead to the breaking of a barrier, while increased aridity may lead to the creation of barriers of rubble from dry talus slopes. In the same way a general increase of rainfall over a long period will lead to a general increase of flow, though this may be adversely affected and even concealed by other factors. There may be an increase of snowfall in the upper reaches of the stream so that the flow is more evenly distributed throughout the year as a result of the smoothing effect of the even melting of snows. This action may perhaps be accompanied by an increase of vegetation, soil cover, the penetration of roots and rhizomes, and so on, all of which would tend to stabilize flow through the year, and mask the results of the increased precipitation. Conversely, increased aridity may mean slighter snowfall with swifter melting, a less effective cloud and vegetation cover, and hence a sharper, swifter flow for a short rainy season, producing easily observable flooding.

It is therefore necessary in any study of river development, to study the individual problem, and to seek real evidence as to the reasons for changes in flow. We cannot be satisfied any longer by such vague and unsatisfying explanations as pluviation, tilting, glaciation, each of which would apply in certain instances, but need the backing of search into causes.

Alluvial deposits

If the cutting of a river were exactly vertical, the deposits underlying would be removed completely by any spate of water. But in practice the tendency to meander, or wind and twist its way past local barriers, makes a river attack its banks, so that remnants of older deposits are allowed to survive by reason of these deviations. Eventually fragmentary formations of gravels, sands, clays and muds are left along the sides of a river on one or both slopes of the valley, often revealing a series of distinct stages or episodes in the life of the river. These generally appear

as terraces — steps or benches formed by the cutting action of the stream. Each is thus the land-form left by a marked change in the erosion cycle of the river. Often associated with terraces are gravels of coarse or fine material (depending upon the speed of the flow that deposited them) which may often include human artefacts of varying ages.

Because rivers cut downwards, the oldest of these gravel deposits is necessarily the highest above river level, unless marked tilting can be shown to have taken place. This seems at first sight to be a reversal of the laws of stratigraphy, but remember that we are here discussing the cutting into, not the building up, of deposits. The first in the series must necessarily be that nearest to the surface of the original plain into which the river is cutting. Any subsequent members of the series will lie against a slope, and not vertically one above the other as they do in a cave.

It should be obvious that everything found enclosed in a higher gravel must have reached that position earlier than the material embedded in a lower (younger) gravel deposit. Gravels do not "date" implements; they only supply us with one limiting date, the time at which the implement became included to form an integral part of the gravel.

Any implement found in a rolled or water-worn condition in a gravel has undergone a long period of river action, and therefore "had a history" before it came to be included in the deposit. In any gravel deposit new material, and also older and earlier gravels, will be included during the process of resorting, as the cutting stream carries fragments of gravel down to new levels. We must thus expect to find heavily rolled material incorporated, together with material perhaps scarcely rolled. The heavily rolled implements have had a long record of water-action, but need not necessarily be of earlier date than those protected by chance against rolling.

Within each gravel two processes are at work. The changing annual speed of a stream will deposit gravels varying from coarse to light. The river in spate will carry and deposit larger material, while lighter material may be carried downstream. As a result we get an appearance of stratified deposits of sand, fine gravel and coarse boulders, or false stratification. But in addition there is a true stratifying action as the slow-moving reaches of

the stream build up or aggrade its floor. In such a case the lowest deposits within a gravel may be taken as earlier than those overlying though in fact each layer of gravel will certainly include elements from the deposit just below.

Material will not only be found within a gravel. It continues to accumulate on top. The surface of the gravel should therefore be regarded as an old land-surface, and any accumulated talus or other material overlying it should be treated as a separate deposit that has reached its position since the gravels were laid down. It may perhaps be stratified within itself, and will contain material of more recent deposition than the gravel on which it rests.

It will be seen that, even in the simple and straightforward cases cited, it is impossible to deduce with certainty more than the relative age of the gravels themselves. This merely gives a clue to the relationship between the times at which the various implements were caught up and included in the material of each gravel. It does not imply that the dating of the implements will conform precisely to the chronology of the gravels themselves.

Certain deductions can be made, but it is first essential to apply the statistical method outlined above. Make typological and technological deductions first, arrange the marked specimens according to this grouping, then see how their distribution is related to physical condition and to particular gravels at varying heights above river level, and finally relate them to the apparent depth within the gravel. Any attempt to arrange material in order of physical condition may prove misleading, though even here probability increases with the comparison of large numbers of specimens from rivers and their associated tributary streams. As in any study of statistical data, the greater the number of comparable instances, the more exact the deductions.

In dealing with a few instances or with material from a few gravels, all we can say is that there is a tendency for older implements to be affected by natural agencies (in this case rolling) for a longer period than implements made more recently. To understand the principles involved, the reader should turn to some of the text-books listed at the end of this volume. There are of course many other general works on geology that cover the same field. Unhappily little has been written on the subject of included implements, physical condition, etc.

Hardness of gravel materials

It is obvious that when we compare the abrasion of two implements we tacitly presume that they are of the same material. This may be true in a flint country, or a T.M.S. country; but where chalcedonies, granites, hardened shales and a dozen other materials are concerned, we can no longer make direct comparisons of relative wear. M. Janmart, a mining geologist on the Angola-Katanga border, has attempted to determine experimentally the relative wearing qualities of stones he finds in his gravels. A stone is held with an even pressure against a grindstone, and the number of turns counted until a measured degree of wear is produced. The number of turns is then marked on a graph paper as an index of hardness. Numerous other samples of the same material are tested, and an average is struck. Other materials are similarly abraded and an average taken for each. In any study of comparative wear some such system is essential. M. Janmart considers that it is possible to develop a general chronology by employing this test.

SPECIAL PROBLEMS

With a view to understanding our particular problems, we can consider a few of those cases likely to be met with in Africa. Glacial phenomena do not fall within the scope of these notes, but references are given in the bibliography to European works dealing with those problems. The question might perhaps arise in the anomalous instances of Kilimanjaro, the Atlas, or Basutoland, but here it resolves itself generally into the annual melting of snows of an order that cannot be termed "glacial". We are more immediately concerned with phenomena that modify the remarks made above on river history.

Changes in base-level

This is a general term, covering alterations in degradation and aggradation resulting from changes in the level of a sea or lake (into which the river flows) in relation to the river mouth; and also from the destruction or development of any barrier to normal flow along the valley of the river. In any change of

base-level the whole river above the point of change will eventually be affected, but the effect decreases as we leave the river mouth or the barrier, and may be completely arrested if there is any real break in the profile of the stream, such as a waterfall, an ill-drained marshland, or a lake with a spillway.

The lowering of sea-level relative to the land increases the speed and cutting power of flow, sluicing out a new and deeper channel in the masses of alluvium collected near the river mouth. The effect is seen in the form of gravels along the river bank to the old river mouth, marking the previous base-level. The cutting action first becomes evident at the mouth, from where it eats its way upstream until either the source or an intervening barrier is reached. Terraces and gravels so left as the land-forms typical of the earlier river level do not lie parallel to the stream bed, but grade with it; they lie on a curve starting from the same point, but diverging slightly and constantly from the new base-level until the mouth is reached. The earlier river mouth, situated 200 feet above the river mouth, may be represented by a terrace at 150 feet, fifty miles inland; and both may correspond to a gravel 50 feet above the stream, five hundred miles inland. Any intervening unbroken barrier will interrupt this grading, so that above a natural dam the stream must be studied afresh, and dating must be in relation to local reaches of the river, and not to the stretches below that are primarily related to changes in sea or lake levels.

A rise of sea-level relative to the river-mouth eventually leads to a building process. The first effect is to submerge the lower reaches, to produce a "drowned valley", in which the stream deposits material, until bit by bit, a new wide valley floor is built up. The earlier gravels will be submerged by the trespassing sea, and finally covered by the alluvial plain.

Oscillations in sea or lake level will thus produce alternate cutting and building in associated river systems. The complicated remnants of this history are to be seen in the formation of terraced steps along the banks of rivers from their mouths towards their sources, but these correspond with terraces and deposits along the shores near the river mouth, parallel to the sea or lake surface.

Distance from river–mouth

It was noted above that the effort to attain a base-level starts from the mouth of the river, or from the debouchement of a tributary stream, or from a barrier to flow, and that it then works its way towards the sources of the component streams. Gravels will therefore grade with the river, and not lie parallel to it. They show a greater height above stream level towards the river mouth than in the middle reaches. A height of two hundred feet may mean little towards a coast marked by raised beaches, but would represent a long period of cutting if encountered a few hundred miles inland. This is especially evident during the youthful period of cutting immediately following the commencement of a new episode of changed sea-level or of local uplift.

Raised Beaches

Changes in lake-level are local phenomena, related to rainfall, evaporation and drainage. Changes in sea-level are of two types, local and general. In the case of local change we are dealing with subsidence, deformation and tilt. This has little value to prehistory, except in so far as it explains changes in the base-level of local rivers. In the case of general change we are dealing with a local aspect of an ocean-wide phenomenon, due to an actual rise or fall of sea-level, resulting from the locking up or release of snows at the Pōles, or perhaps to a slow loss of water from the earth's surface over a period of thousands of years. In general it is related to the phenomenon of glaciation. In the case of land-locked inland seas or lakes, changes in level will of course only yield us data for the confined shore-line. In contrast, oceanic changes of level can be observed all along the world's coastlines and will eventually be collated to yield a continuous series of geological dates.

While subsequent erosion of land surfaces will destroy the greater part of any raised beaches left by a fall in sea-level, fragmentary remains can be found at various heights all about the continent of Africa. Where the exposure is well preserved, three levels can sometimes be recognised in the beach: the submarine portion, the true beach, and the upper or storm beach. The submarine beach is relatively flat, and shows typical sands and shell fragments. The true beach contains shingle, shells and

light pebbles, and standing rocks are heavily weathered and rounded by constant sea action. The higher storm portion is generally steep, and shows much coarser material, often mixed with fallen angular blocks of talus and scree from the shore, and between the blocks smaller pebbles and large shells may be caught up. In most cases, except in the more recent beaches, the shell has been broken down into a lime deposit, and even this may have been leached out and redeposited elsewhere, so that only weathered and rounded pebbles will provide a clue to the origins of the deposit.

The phenomena of changing level are generally accompanied by other manifestations. For instance, where there has been a relative retreat of water level there may be wave-cut caves or notches at the old level. These have frequently been inhabited by man at a later date, and any deposits found in such a cave must be later than the drop in sea-level. Such caves normally lie parallel with the sea, and depict remnants of the older shore. In some cases an old sandbar or coral reef, running parallel to the coast, may be left above sea-level to enclose coastal lagoons and the beds of serpentine streams, such as occur between the George coast and Knysna. Beach deposits containing old sea-shells, pebbles flattened by washing to and fro on the shingle, and (in rare instances) human implements are to be observed at various points along our coast. These raised beach deposits should be looked for on the appropriate Geological Sheets of the coastal area, and some assessment made of the surrounding deposits that have supplied the pebbles and materials of the beach.

Where changes in ocean level occur, raised beaches are normally horizontal (though sometimes distorted later by folding and faulting) and are general. Beaches left by land-movements grade with the formation that has produced them, and are not horizontal, though they may stretch along many miles of coast. They are associated with faulting, folding and rifting of the land surface inland. It should be obvious that submerged beaches or underwater caves left by a rise in sea-level, or by a local subsidence of the land, are inundated, and therefore useless for our purposes. It must be remembered that an uplift of land creates a new raised beach, but it also raises the level of all other raised beach deposits locally.

Enclosed lakes show analogous phenomena, but changes in lake level are due to a variety of causes. A natural dam may break through and drain the lake partially or completely. Evaporation may exceed intake during a long period of drought. This may be annual in the case of a vlei in a summer-rain region. In the case of increased rainfall over a long period, precipitation may exceed evaporation, and the lake level may rise. This may continue until a natural spillway is reached, when a period of cutting may lower the spillway, and the lake level may fall once again with an increased discharge. In either case a smaller lake results, and each case must be considered on its own merits, after careful consideration of all the factors involved. It is useless to attribute an effect to a particular cause unless the cause itself has been efficiently studied.

Increased evaporation, in contrast to draining, will increase the salinity of the water of a lake, which will in turn affect the character of the fauna, especially certain species of molluscs. It is therefore sometimes possible (within wide limits) to determine the changing salinity of the water by a careful study of the habits of the molluscan fauna. This is especially to be seen in the proportions of different molluscs that have been able to survive varying degrees of increased salinity. The material for such a study should be sought in the raised lake-beaches.

In dealing with implements from raised beach deposits, the rules are much the same as for river gravels: non-rolled material is of later date than the beach, while rolled material included in the deposit is earlier in age than the beach itself.

Soil creep

This describes lateral movement between an ancient deposit and a more recent one. We spoke earlier as though gravels and beaches were left in neatly arranged series beside a river or sea. In many instances we find (in the case of river gravels) that where cutting and building have alternated, one gravel may have been built up in such a way that it overlaps, or is juxtaposed to, or even partially covers an older gravel. This happens where the intervening cutting action has been shallow enough for subsequent building to reach an equal level. Such a complex is difficult to recognise, but can usually be detected by a careful study of

oxidation, general colour or source of the materials forming the adjacent gravel deposits. Differences in the fauna and types of implement from two sites in an apparently homogeneous gravel should lead one to a careful re-examination of the surroundings in an attempt to distinguish variation in patina, texture and colour.

Lateral streams

An important factor in dry countries is the intrusion of false gravels containing human materials, by the action of dongas, tributary streams and the like. These are independent of the main stream and often interpolate later material from the surface to a considerable depth. Cases occur in which waggon-wheels, modern china, Chinese trade-carvings and other dateable refuse have been found at depths of thirty or forty feet in apparently undisturbed strata. Care must therefore be taken to watch for any disturbance or resorting within the gravel layers. A donga will refill with rubble from the layers through which it has cut, so that the colour may often be unchanged, but local disturbances in the false stratification of the gravel should be recognisable. The effect may be a result of "pot-holing", the swirling of an eddy which gouges out pits in the surface of gravels, and even of rocky surfaces. These hollows contain pebbles rounded and worn by the action.

Unequal valley cutting

In any attempt to assess the relative age of river deposits set at similar heights above river beds, it must be realised that each of any series of tributary streams has had to cut its path through a different series of rocks and deposits, or through the same deposits, but at different angles, and each has been fed by a dissimilar precipitation falling in a different catchment area. The presumption that Terrace A. in one stream is of similar age to Terrace B. in a second tributary, because both are the same height above stream level as Terrace C. in the main river, could only be maintained if we knew the relative speed of cutting, the history of precipitation, and the causes of terracing for each separate stream. At the same time it must be remembered that any deep cutting of the main stream channel will be reflected in the subsequent attempts of the lateral streams to attain a comfortable base-level. Each main river and each tributary stream

must be considered on its own; only then can the several events be correlated. The possibility that what is to-day the main stream may at one period have been a minor tributary must also be kept in mind.

Reversals of river-flow; tilting

Tilting is well known in parts of East Africa, Uganda, the Congo and the northern parts of Angola, where forces that have accompanied the creation of the Great Rift Valley systems have sometimes succeeded in reversing stream flow. There are three possible results of tilt: reversal of flow, increase of slope, and decrease of slope. All can be recognised by the regrading of gravels with the "new" stream. Increased slope involves a period of degradation or cutting, while decreased slope may produce aggradation or building. This is of major importance only where land surfaces have been affected by volcanic and earthquake action during the human period. Such effects are certain to prove partly compensatory, so that if one area is forced up by subterranean action, another will tend to drop. Action of this sort seems to have been successfully described by O'Brien in Uganda, F. Cabu in parts of the Congo basin, and by others such as Janmart, Martelmans and Droux in other parts of the same basin. In the southern Congo the main direction of drainage is to-day from south to north. There are strong evidences that the drainage within the human period was from south-east to north-west; old valleys cut diagonally across the present river beds. This is probably due to some continental uplift towards the west coast of Africa. Such movements may be cataclysmic or quite gradual, and indeed local movement can be observed as continuing processes to-day. It is therefore necessary to remember the possibilities of earth movement in other parts of Africa, but quite unnecessary to evoke them as simple explanations of apparently incongruous episodes.

Dr. A. L. du Toit has noticed a rather different phenomenon east of the Kaap Plateau, due to uplift along the Griqualand West-Transvaal axis. The south-easterly tilting of the junction plane between the softer Karoo formation and its harder volcanic basement has caused the Vaal River, which follows the boundary closely, to side-slip towards the south-east, scouring away the

softer formation and its sandy covering, and abandoning its important gravels towards the north-west. According to the Abbé Breuil and Prof. van Riet Lowe, part of that tilting occurred within the early human period.

Reversal of flow is not necessarily due to tilt. The capture of the headwaters of one stream by another (that is, in cases where a stream cuts back in such a manner as to rob the springs and sources of a river flowing in the opposite direction), may in certain instances yield a reversal of flow in the upwater region of the robbed river. Generally the intervening watershed has been so cut into by this capture that little of the original head-water deposits will remain intact. This seems to have been a common state of affairs at the Cape, where such rivers as the Breede, Bot, Berg, Rool Els, Eerste and Palmiet, all show signs of loss or gain through stealth. Here again, while older gravels graded with the earlier stream, the newer terraces will grade with the new river bed. Unhappily there is seldom sufficient of each gravel deposit left to be certain of the true relationship of each to the others. A survey of the terraces, benches and land-forms of the valley with the help of a large-scale contoured map will often yield some result.

Pluviation

The terms pluviation and wet-phase should only be employed for the major and minor phenomena resulting from long-term increases in precipitation, recognisable over a wide area, and sufficient to produce a marked change in plant-cover. Where possible, recognition of simultaneous and consistent increase in two or three neighbouring but distinct rivers, or tributaries of the same river system, should be sought and affirmed by a competent geologist before the terms are applied. To deduce pluviation from the Vaal-Harts basin is one thing, to make a local town-spruit provide evidence for a climatic cycle is quite another. Flood-action or spate will satisfactorily cover local increases in flow, and must not be confounded with major phenomena. In particular years, under certain conditions, a single cloudburst can effectively produce local changes that may suggest major climatic change. In the same way the facile correlation of one local deposit in a small stream with pluvial phenomena that have achieved some

acceptance, is to be avoided. Correlation means making a local survey over some miles of main and tributary streams.

It must be remembered that a distinct increase in average rainfall may, by reason of the eventual increase of plant cover, humus and root penetration, lead to an actual decrease of flood-action, by providing a slower and more even annual distribution of flow through slow surface drainage, tributary springs and seepage, instead of sudden floods of surface waters.

Pluviation and glaciation

This is not a field for the amateur. There are many sources of error, some few of which we can touch upon here. Fundamentally the relationship between these two phenomena depends on our recognition of implement types in two or three very different areas. There are two underlying presumptions employed in each area: agreement as to the association of implement types with specific pluvial or glacial phenomena, and agreement as to the number of glacial or pluvial periods that are to be accepted in any one area. There is little uniform opinion on either of these apparently simple questions. Evidence points conclusively to three, four and five glacial maxima in different parts of Europe, and while it may be reasonably agreed that one glacial action may wipe out all traces of a previous one, it is by no means agreed which glaciation did the wiping out. Glaciers have a differential distribution, and some glaciers were certainly not so widespread as others; here again the question is, which glaciers are represented at which sites? There is similarly little agreement as to the relationship between human cultures and the glacial deposits. It is only within the last few years that a survey of Western European sites by the Abbé Breuil, Koslowski, and others has led to any measure of agreement on this point. If agreement upon facts cannot be reached within Europe, it is hardly likely to be reached here if glaciation and pluviation are regarded as aspects of a single phenomenon of precipitation.

There are two general schools regarding the theory of the relationship between these two major phenomena. One regards both as due to simultaneous increase of precipitation over the earth's surface, so that glacials and pluvials roughly coincide.

The other regards the phenomena as due to a climatic swing from the temperate regions to the subtropical and back again, alternating phenomena, so that glacials will coincide with interpluvials, and pluvials with interglacials.

Prejudice now colours deduction. There is a desire to relate four pluvials with four glacials, or two pluvials with two pairs of glacials. If three pluvials are accepted, the one covers a pair (selected by mutual agreement), the other two coincide with two glacials. The opposing school makes three pluvials agree with three interglacials, or five pluvials may be made to precede and succeed the ice-age, while the remaining three will again coincide with interglacials. Those who believe in an uneven number of pluvials tend to accept the alternating theory, while those who accept an even number of pluvial periods prefer the theory of synchronism. The whole question has so far been dependent upon guesswork, prejudice and wishful thinking, with a minimum of foundation in fact.

Similar presumptions regarding the pairing or association of pluvial phenomena within the continent of Africa may be based upon somewhat greater probability, but even here it behoves us to be very guarded. To-day the climate west of 28° East long. is symmetrical, the south providing a slightly limited mirror-image of the north. It is perfectly possible that such was the normal arrangement throughout the history of the continent, so that a slightly ameliorated Sahara climate would be reflected in the Kalahari, while a pluvial period in the Tunisian winter-rainfall area would be reflected in the Cape of Good Hope winter-rainfall area. A similar reflection would govern the summer-rainfall areas of the Transvaal and the Sudan. Unhappily Kenya is on the equator and can therefore be made to yield no image in the mirror, while nothing is yet known of conditions at the Cape. It is of extreme importance to note that the phenomena typical of pluviation will most certainly not be identical in winter, summer and equatorial rainfall areas. It is the interrelationship of these that will provide our greatest problem in the near future, and presumption is not enough. Science cannot be based upon "mutual agreement" where fact is concerned. Agreement can only be made to cover theory or hypothesis, and can never include the factual basis.

Subaerial action

During periods of relative aridity or in areas where dry winds prevail, "pan" conditions are generally encountered. The term covers wind-excavated depressions, undrained and apt to contain water, scattered throughout the drier parts of the country. Typical of the pan is the production of *brak, kalk* or *alkali,* i.e. sodium, calcium or potassium salts. These salts are due to the annual accumulation of water penetrating the underlying surface, dissolving local salts, then being evaporated under wind-action during the dry season, with precipitation of the salts at or near the surface. The crust forms a partly protective layer preventing further wind erosion of the pan, but where it is absent the "dust-bowl" effect scours out the earth's surface until either bedrock is reached, or the rim of the pan is sufficiently high to protect the floor from wind. A marked amelioration of climate will generally turn a pan into a lake, or create a marsh protected by plant cover.

Wind action will undercut soft soil from beneath boulders, and even stone implements, slowly lowering them to a new level. At the same time a stone will become polished, pitted, differentially worn into hard and soft layers, or even "stream-lined". These last occur as *driekanters* in windy areas, and consist of stones which have been bombarded by windblown sand consistently in one direction. They are often mistaken for Neolithic implements. A triangular tailor's crayon shape, and a propellor shape are common. The tetrahedron also occurs. Windwear can generally be recognised as it gives the object a queer similarity to an underexposed photograph, owing to contrast of light and shade produced by pitting.

Sand-dunes

Sand-dunes are of two general types, shifting and consolidated. The latter are fixed by the cementing action of iron or lime salts in the dune, or by protection from wind through the presence of plants. It is often important to assess the origin of the salts that occur; they may be products of the soil but often have their origin in raised beach deposits or shell middens.

If there is uncertainty as to the immediate origin of the sand, it should be examined microscopically for sharpness. Rounded

corners and smooth faces to the grains show water as having been the immediate vehicle. Flinty sharpness and dulled facets show wind action. I say "immediate", as windborne sand may become waterborne within a matter of years or miles. Even the validity of such a simple answer as this has been questioned, and many sands do not yield any clue to their origin.

The shifting sand-dune generally takes a *barchan* form — a crescentic dune whose concave lip is always tumbling forward as it is fed from the direction of the convex edge. The two horns face the direction of prevalent wind-flow, and are lower than the centre of the dune. The action is much the same as that of a toppling wave. Light objects may at times be floated by the sand, but heavy material will sink to the underlying ground-level, producing chance association at depth, when the shifting dune happens to consolidate.

Chronology

It will be observed that nothing has been said concerning chronology. Both geology and excavation yield two types of chronology, — relative order and a broad time relationship. We are only permitted to say from our evidence: "These things occurred here in this order. The time covering this sequence must have been of such a magnitude." We have no gauge of time in terms of years, centuries or even millenia. Our only comparison must be in terms of other things, the time necessary for a geological action or for a climatic change to have occurred. Even comparisons with a field 5,000 miles away, with the Mediterranean, the Sahara and the Congo forests between, need have no relation at all to fact. Even in Europe no dating previous to 8,300 B.C. (circa) has any value.* The usual system for reckoning archaeological age before that period is best called "twicing". If such an object is 5,000 years old, then this one must be twice that, and that one must be twice that again. This is unsatisfying, as we constantly double our error. But if we give the question a little further consideration we see that the human mind works in much the same way in thinking of time. Thinking back we say: "Five minutes ago, — yesterday, — last week, — last month, — last year, — when I was a youngster, — during the Renaissance, —

* See Graham Clark. Archaeology and Society, page 141.

before the Conquest". With each step our terms of reference grow wider.

There is a further aspect of chronology that has not been touched upon — persistence. We are apt to think of a series of neat clean-cut periods, each ruled off like a ledger on quarter-day. We unconsciously believe that quarter-day at the Zambesi is the same as at the Cape Peninsula. Things don't happen like that, more especially in a continent where there have been no major cataclysms such as glaciation. To-day we have three "periods" in man's history side by side in the same country — the Bushman, Bantu and European. In the same way there have certainly been great lags and persistences in the prehistoric period, but we do not know when they occurred, and we never shall so long as we work on the presumption that like cultures were necessarily simultaneous in different areas. Dating a culture by its typological resemblance to another is argument in a circle. Local reversals of recognised order may even occur.

General

The evaluation of geological records is not the field for the amateur, either in geology or in prehistory. It needs long and considerable training, and in addition the backing of long experience of Quaternary deposits in similar climatic environments. A very considerable knowledge of local and appropriate literature is essential. Chronology in one area should not be presumed true for another.

XI.

PRIMITIVE ART SITES

Their very labour was to them as a painting.
Hen. VIII. I. i.

Paintings

Apart from deposits, an eye should be kept open for signs of paintings or scratched designs. These may occur obviously on the cave wall, but they may be less obvious twenty yards away from the deposit on a neighbouring wall, or as almost invisible remnants of old paintings in the cave.

The state of preservation of paintings seems to be a product of a variety of factors:

1. Original solvent of the paint; marrow-fat, water, etc.
2. Permeability of the rock surface.
3. Chemical action conducive to the decay of the rock face.
4. Organic or inorganic destruction of the paint or its solvent; bacteria, lichens, etc.
5. Proximity of trees to the cave wall; these may either protect the paintings or, more commonly, help to destroy them.
6. Protection from weather conditions, bushfires and grass-burning.
7. Animal action; sheep or cattle housed in caves during the winter, or the destructive action of hyrax, will destroy paintings by friction.

The Zamenkomst slab, our most famous painting, was preserved by chance. It had flaked off a cave wall in a single tremendous sheet or spall, and had fallen forward on to the cave floor, where, happily, conditions were favourable for preservation by the South African Museum, Cape Town. In some instances, thin sheets of stalactitic lime have formed over paintings, so that they have been preserved. This skin of lime should never be interfered with.

Some study of a painting is necessary, and we should know what we are seeking. Here is a list of some of the points that should be recorded, but the list can be easily augmented.

1. Presence or absence of superposition.
2. Presence and types of grouping.
3. Colours (as accurately as possible) used in each style.
4. Assessment of styles: conventionalised, childish, naturalistic, distorted (elongated, short and thickset, triangular bodies, hooked heads, etc.).
5. Content: scenes represented, portrayal of hands, dots, lines, aprons, "devils", animals, scenes, etc.
6. Method of application of paint: as a dry powder, rubbed on as a paste with the fingertips, as a wash applied with a brush, or other means.

Superposition and grouping

As in stratigraphy, so in parietal or wall paintings, superposition can be made to yield evidence of the order of styles. Thus in one cave may be found simple primitive daubs made with the finger-tips in a single colour. Overlying these may be more advanced paintings in very different style, perhaps in a single but different colour. Superposed on one or both of these may occur advanced styles, paintings in polychrome, red, white, black, yellow and brown, etc. There may be later deterioration and a return to simple figures in a single colour, or perhaps conventionalised polychromes, far less naturalistic than the former period, or lines, hands and dots in a single colour. Such a series forms a palimpsest, and can be made to yield a clue to order within an area, by the extension of the study to form a localised regional survey. Burkitt touched on the distribution of styles and colours of painting, and showed that they were intimately related in some areas. His method of expressing superposition as a fraction, one colour or style written above the other, is quite the best method for note-taking.

False grouping

As a result of the habits of our prehistoric artists, the same suitable surface might be used again and again for painting.

Once an old picture had faded sufficiently, a new one might be painted on the same surface in new and brilliant colours. When this had faded in its turn, a third might follow. Each in its time was clear and bright enough to cause the older paintings to tone into the general colour of the background of rock. To-day the brightness of even the latest paintings has gone, and it is at times difficult to see the true relationship of one layer to another, and to discover the grouping that was intended. So far as my investigations have gone there are three types of grouping to be considered:

i. True grouping. Styles and colouring homogeneous, and the various elements truly related to one another to form a single unit or picture.

ii. False grouping. Due to an artist adding appropriate figures in new styles and colours to an earlier but fairly bright group. The Zamenkomst slab (South African Museum) falls under this heading. The human figures belong to a different style and are of later date than the elands.

iii. Independent superposition. Where a bright painting has been made over an old, dull painting, and both have faded to much the same tone to-day. Here grouping is palpably false, and discrepancies in style, size, content, colour and arrangement all show that paintings have no relationship to one another.

Interpretation

Care must be taken when studying either paintings or rock peckings and engravings (which I group here as Petroglyphs) to guarantee that our interpretations have some relation to probable fact. We must ensure that our reading of a scene, or our identification of a plant, human or animal form, has evidential value. While we know that many of our early South African artists were steatopygeous (fat-rumped), and can therefore accept steatopygy as proper to the race, we cannot suppose that a people ever existed that approximated to the "Daddy-long-legs" paintings of Southern Rhodesia. In the same way, no race ever inhabited Spain with waists thinner than their ankles. A striking example of faulty identification (based upon a wrong

presumption that the most striking element yielded a clue to genus, and that the remainder of the petroglyph was anatomically in keeping with this feature) was the famous "Transvaal mammoth" which caused some stir in scientific circles a few years ago. I was able to show conclusively that at Vosburg in the same style and period of art, trunks and extra legs were added indiscriminately to zebras, quaggas and other animals by the artists themselves, even though an excellent likeness to those animals had been achieved. The mammoth proved to be a rhinoceros. In groups of animals within which identification is somewhat difficult, such as certain birds, small buck or fishes, care must be taken not to be misled into a rash identification by a single striking feature. It is possible (even likely) that the feature was a product of wrong drawing. In much the same way, interpretation in terms of our own cultural history are unsafe. Paintings and engravings of the Bushman "Eland Bull Dance" are often described in terms of our own medieval devils. The customs of existing peoples are often descended or borrowed from prehistoric usage, but even here caution must be exercised, and theories should not be pyramided on an insecure foundation.

Collection of data

Paintings should be photographed. This is a somewhat difficult matter, and it is often essential to waste a few films learning how to get the best results. The following exposures should be tried in an order that can be recognised when films are developed. An underexposure, a normal, and an over-exposure, a normal exposure with filter I, and another with filter II. This should yield one good result, but it is essential to be able to remember which exposure provided the best reproduction. I have found that the slower Agfa film-packs (and presumably other makes) will represent reds on a dull rock face better than the faster colour-sensitive films, which show both as grey. In general, unless a high-speed f3·5 lens on a reflex camera is used, employ a tripod, using a small stop and a fairly long exposure. This increases definition.

Next the painting should be traced on butter-paper. This is held in place by a helper, and tracing done partly through the paper, and where this is useless, by carefully folding back the

edges of the paper without moving its position. Every colour must be written in wherever it occurs, or tinted on the paper. Tracings may be reduced by pantograph.

Photographs and tracings are now taken home, and the best film is enlarged to as great a size as possible, using a matt-surfaced paper. It is best to underexpose the print slightly and so avoid contrasting black and white, or else use a non-contrasty paper. The surface of the enlargement should be kept absolutely free of grease from hot hands, etc., to permit transparent water-colours to adhere evenly. Using the tracing as a guide, colour in the background of rock, then paint in the various animals and humans. This must be done in proper photographic transparent colours, and carried out in daylight to avoid over-accentuation of the yellows. The work is difficult but enthralling. It can be handed over to a professional if the tints are accurately given on the tracing.

Coloured transparencies photographed direct from paintings have been very successfully tried in Rhodesia. The main difficulty at present is to print a diapositive colour-film on paper for eventual reproduction. This is being overcome, but it is still expensive. In considering expense, the time taken in tinting, and the accuracy, should be considered, also the need for a return to the site.

The reproduction of a tinted photograph for publication is an expensive process, and may cost as much as a pound per square inch. Paintings can be reproduced more cheaply (from a shilling to five shillings per square inch, depending upon the number of colours used) by making a line block, which may involve a three-colour printing process with no very great accuracy in the reproduction of exact tint. To prepare a three-colour line-block illustration, the enlarged photograph (untinted) is placed over a sheet of plate glass, with a strong electric light behind it. A sheet of good but thin paper is placed over the enlargement, which is then carefully traced in colour, using the original butter-paper trace as the colour guide. The rock wall should be ignored, or when the blocks are finally printed, a coloured drawing paper may be used. Khaki, brown paper, stone, mid-grey, dark-grey, fawn, or olive are useful colours. The mid-grey and dark-grey will represent granites well enough. Avoid half

tones, and use flat and consistent colour washes. Add a scale of size.

Whatever type of reproduction is intended, return to the site to compare your copy with the original. Note especially whether your tints, superpositions, etc., are right, and see that you have given a fair representation of the objects shown and the styles in which they are drawn. A return is unnecessary if a direct colour-photograph has been taken successfully.

Petroglyphs

Similar methods to those employed for paintings can be applied to petroglyphs. Miss Wilman has made some use of these methods in dealing with the engravings of Bechuanaland and Griqualand West. A more detailed local study can be seen in my Vosburg paper. In this latter paper the causes of patination and deterioration of petroglyphs are gone into in some detail, and the reader is referred to it for information. Reproduction is best seen in papers by Péringuey, but these are museum products, and not field photographs; a very different proposition. The same is true of most of Holub's engravings published by Zelizko.

The following points should be noted, using much the same methods as those suggested above for paintings:

1. Superposition.
2. Grouping.
3. Techniques: scratched, rubbed, chemical, pecked, engraved in fine line, cross-hatched, deeply scored, etc.
4. Styles: conventionalised, childish, naturalistic, distorted, the presence of additions either by the artist or a later hand (this may provide evidence of relative chronology of styles).
5. Content: scenes represented, animal types, water, plant-forms, humans, patterns, designs, etc.
6. Implements contiguous to the engravings, and suggestions as to whether they are associable or not, whether they have been employed in making the various styles, etc.
7. Patination: allowing for differences in technique, depth, etc.

When petroglyphs were originally made, they consisted of the removal of the skin of patina by some means, to reveal the

contrasting colour of the underlying rock, or the lighter tints of the underlying skin of patina. They were therefore more easily visible.

Engravings react well to photography, if the need for top-lighting is remembered. A camera affixed to a seven or eight foot stick, with an accurate focusing device, I have found better than a ladder-tripod, as this is apt to get caught in the wind, and is difficult to carry about over rocks. Photographs can be printed as sepia-tinted reproductions, and need no colouring.

If a prism or a surface-silvered mirror is used, remember that the image is reversed on the film, and must be carefully printed in reverse once again. In order to produce contrasty photographs of rock surfaces, I have found it useful to print the film either by enlargement or contact on to a slow plate. This is developed, and reprinted on to a second plate as a new negative. A careful use of underexposure, overdevelopment, and Farmer's Reducer (potassium cyanide) will often bring out lines and patterns on the rock that the original negative gave badly. Again, avoid all "faking", as it detracts from the value of the work. This applies in the field, where oiling of the rock surface should be avoided. If it must be used, state it in publication. Oiling should never be permitted to bring out chance peckings on a rock in such a way as to interpolate them as parts of the original picture.

Plaster casts

These are useless unless the markings on the rock can be clearly felt with the fingers. Light *graffiti* do not make themselves clear in a cast. For a separating medium a wash of yellow soap is best, though other materials can be used, but they must not be of a type that will affect the rock surface or its delicate patina. Wash the soap all over the rock as a very dilute liquid, and allow to dry, blowing away bubbles as they form, and seeing that the soap enters every cranny.

Prepare the plaster in a washbasin or bucket, and apply it quickly. The time from first mixing and completed application must not exceed five minutes. Before setting, a sheet of wet butter-muslin can be spread all over the sheet of plaster. A

second layer of plaster can be applied to this, after the first has been wet once again. This makes a re-inforced cast. For very large casts fencing wire, sacking and even piping or light fencing stretchers can be incorporated, but some knowledge of the action of plaster is necessary.

If there are no undercuts, and if the soap has been properly applied, the dry cast will come away in one piece. If further sections are needed, trim the edge of the first cast at right angles, leaving a wavy edge, so that the relative position of the two slabs can be reconstructed. Soap the edge of the first cast, place it in position, and repeat the casting process, using the edge of the first cast as the limit of the new. This can be repeated indefinitely. A cast should never exceed three feet in any direction, and if the boulder is small, much less. One to two feet by half-an-inch thick is a better size in most instances. Joins should not occur over the detail of a picture, but only between figures. Do not work the plaster after it has started to thicken. Do not attempt to remove until the first set has completed and the drying out process has at least begun. If there is any difficulty, allow further drying, but do not lever the cast off the rock, except as a last resort. The error in such a case will be failure to recognise undercutting (an undercut is any overhang of the stone under which the plaster will wedge), or else failure to cover the rock with soapy water.

The correct mixture of plaster is obtained thus: Place as much water as will represent the needed quantity of plaster into a wide-mouthed bowl. Take plaster, and sift it over the centre of the water, without mixing. Directly an island of dry plaster remains above the water-level the proportions are correct. Mix deeply, quickly and carefully to avoid lumps, for a minute or two, not longer. Have everything ready, and apply quickly with a large spoon, cup, etc. Plaster takes an average of ten minutes to set. A dentist or dental mechanic will teach far more on the subject of plaster than any book.

An excellent recipe for retarding and hardening plaster is as follows:

Anhydrous pot. carbonate	1½ oz.
Borax	½ oz.
Tap-water	½ gallon.

Paper presses

These are only suitable for coarse peckings, as detail of fine engravings is often lost, and there is often a considerable distortion of curve. Paper (printer's flong, unprinted newspaper, brown-paper with parallel watermark lines, etc.) is soaked in water, pressed in the hand until crumpled and damp, but not pierced. The rock surface is oiled or vaselined lightly, and the paper is applied to the surface in pieces as big as the hand until the whole rock carving is covered, without overlap. To this a second layer is added, this time soaked in a thin 1/5 casein, (allowed to stand for half-an-hour) or a glue-solution. A second, third and fourth layer of glued paper are applied, and a final layer soaked in water is added. In applying the layers they should be stumped into the design carefully with a square-ended brush. Do not remove until the whole is perfectly dried out. It is a good thing to allow each layer to dry out partially before the next is added.

One advantage of this process is that the paper press can be stored easily, if proper precautions are taken to keep off silverfish, etc. A small percentage of poison added to the glue is useful. Paint with a 5% formaldehyde solution. This helps to set the casein glue.

Art mobilier

Applied art is not very common in Africa, and though simple carvings, sometimes dating from the Middle Stone Age, and scratched figures on patinated implements do occur, they appear to be the scratchings of individuals rather than a true part of common cultural tradition. It is possible that art was applied to wood, but even were this so, we would expect a better reflection in soft stones, bone and ivory where the techniques are analogous.

Delightful applied art is to be found in nacre (mother of pearl) from Haliotes (Venus' ear) on coastal midden sites, and analogies are to be found in the preparation of "slate palettes" (certainly used as trowels, as were similar wooden slats within living memory) at inland sites. Bone tubes are often lightly decorated with cross-hatching recalling the superficial *graffiti* pictured by von Luschan from Southwest African Bushman

ostrich-eggshells. Fragments of similarly incised eggshells occur, though rarely, from cave sites. Among the existing Bushmen a study of designs still painted on leather quivers will yield a valuable clue to the interpretation of the symbolism and meaning of paintings and engravings. Miss Wilman has made some study of this in the work quoted.

The preservation of *art mobilier* in ivory, bone and wood, may need the careful and practised use of preservatives such as beeswax in turpentine, shellac varnish, water-glass, etc., each of which has its appropriate uses. This should only be undertaken when some knowledge of the use of the preservatives has been acquired, and after the complete drying out of the specimen. A few very inadequate notes on preservation in the field are added. (Chapter XII.).

Designs on tubular objects can generally be clearly reproduced by carefully rolling the object over a flat sheet of modelling clay, putty, etc., sufficiently hard to give a flat impression of the design. This can be cast in plaster. Remember that the maker never saw the engraving in that form; it is merely a useful means of reproduction. This can be appropriately tinted and rubbed over with French-chalk or talc to remove the harshness typical of plaster casts.

Very great care should be exercised in dealing with the water-worn gravestones that are sometimes found over coastal burials. These are generally painted on the under surface, and the paint has deteriorated and levigated to a fine pastel-like powder, probably owing to the destruction of the fatty medium by the bacteria proper to death. The only possible answer to this is to dry the rock slowly, and to spray the surface with an alcohol solution of clear white shellac. The ordinary brown commercial shellac should not be used.

XII.

PRESERVATION AND PACKING

What comfort to this great decay may come
Shall be applied.

Lear. V. iii.

Stones

Unless these have been rendered friable by heat, all that is generally necessary is to pack them in such a way that they do not chip one another when travelling. Take a strip of newspaper about eight inches wide, start rolling at one end, adding a handful of implements at each half turn. Place the roll so made into a marked collecting bag, with the usual inside label in the bag. If stones have been completely changed by the nature of the soil, pack accordingly. Fire or the leaching out of cements will sometimes reduce stones to sand; paint or impregnate these with glue.

Wood

Wooden objects have been found in exceptionally dry shelters, though even here they probably do not have a very long history. So far they have consisted of wooden handles to mounted implements. If possible they should be painted with a weak cellulo-acetone solution *in situ*. Trade "Durofix" dissolved in twice its volume of butyl-acetate will do. One of the main dangers with wood is that it is generally heavily impregnated with mineral salts, which will effectively prevent glue, gum arabic, dextrine, etc., from setting as these take up the water of crystallisation. A second difficulty lies in the powdery surface of the decayed wood, often preventing the use of anything but a fine spray as a protection. The spray effect is best produced by the use of an ordinary artist's varnishing spray (two tubes meeting at right angles), or the analogous fly-spray. Beware of flame.

Teeth

While teeth survive as recognisable objects far longer than most other organic material, they tend to cleave, scale or become

schistose. In cleaving and scaling the fragments can generally be glued into position temporarily, and if the teeth prove of value, they can be more firmly cemented when back at the museum or laboratory. Teeth have a double value to pre-history. They provide information about the faunal associations and food-supply of man in each period; but they may also provide the zoologist with data for the recognition of new or rare species.

Ivory

In the case of ivory every precaution should be taken. Prehistoric ivory is almost always confounded with wood. It splits naturally into slightly concavo-convex layers, perhaps ⅛″ thick, and takes on the texture and colour of a fine-grained brownish wood. Common sense should immediately suggest that a carefully preserved piece of " wood " in a layer completely free of recognisable twigs, and other wood, is suspect. I have found the best treatment to be the slow and complete drying out of the specimen away from sunlight, after which the plates can be soaked in a milky solution of beeswax in turpentine, generally for a few days. If the plates have separated they can be carefully placed in position while the solution is still wet, and the whole allowed to dry on three pin-points, to permit even flow of air. The ivory is now as strong as solid beeswax, and should be handled with reasonable care. An addition of painter's driers might be an improvement.

Skulls

Great care should be used in removing a skull from its grave. It should be protected from sunlight, and allowed to dry out superficially before removal. As a skull is almost always filled with fine damp grave soil the complete drying out process is too long, and also the skull is unexpectedly heavy when lifted from the grave. After clearing the soil through the *foramen magnum* (or basal hole) by means of a knitting needle, sieve the soil through a fine sieve for bone fragments, teeth, beads, and anything small of that sort. Dry the skull away from sunlight. If the skull is fragmentary or distorted, leave all reconstruction to the anatomist, but collect every available particle of bone, and pack most carefully. If it is cleanly broken or has separated along the natural joins or sutures, it can be repaired

when quite dry with cellulo-acetone (one in four solution); this can be obtained commercially under a variety of names. Keep well corked, but take along an additional supply of acetone, both for dilution and for touching the edges of a join to make sure that the celluloid solution sticks thoroughly.

Careful replacement of teeth in their correct sockets can be done with small quantities of plaster of Paris, made with size-water (half-a-teaspoonful of powdered glue-size to a pint of hot water). If there is the least uncertainty as to where the tooth should go, place it in an envelope with the small bony fragments, and slip it into the skull through the *foramen magnum*.

Long Bones

It is often difficult to realise how fragile long bones become when organic matter has been leached out. Never rest on the long bones when excavating; never use them for a fulcrum in even the lightest leverage; never undercut them until they are to be finally removed; dry them out away from sunlight; pack so that there is no risk of any weight or strain on the shank. If a long bone breaks cleanly it is seldom worth mending, and packs better in two or three parts. Avoid the possibility of abrasion especially at the clean breaks. A pin made of fencing wire will often help to reconstruct a long bone. It is inserted like a dowel, and cemented with plaster of Paris made with glue-size (as above) or cellulo-acetone, which can be made by dropping scrap celluloid into a bottle of acetone.

Inexpert repairing must be avoided. Clean all edges before repairing. Do not use fish-glue, or other water-soluble cements, as these will not set in the presence of crystalline salts.

Small Bones

The bones of each hand and each foot should be collected separately in four bags — paper sweet-bags will serve. Mark the bag "left-hand", "right foot", etc., with reference to the skeleton. Pack with remainder of skeleton. The spinal column generally holds together well if threaded on a string loosely. The knee-cap, coccyx (tail-bones), atlas (uppermost vertebra) and other small but complete bones should be placed in a bag, and labelled. Pack with the original skeleton. Ribs appear to

be of little value to the physical anthropologist, but should be collected as carefully as any other bones.

Associated Material

While grave infilling may consist of anything thrown in from layers between the grave-surface and the bottom of the grave, there are often special objects, bone arrow-points, bored stones, crystal implements, beads, etc., that are essentially part of the burial. These should be carefully packed, and kept in association with the skeletal material, after exact photographic and written records have been made *in situ*.

In general, if there is any fear of marked deterioration of a specimen, photograph it on a white, grey or black background in diffused light, and make drawings, adding in exact dimensions. Do not handle the specimen more than necessary, dry it out slowly, brushing away crystals with a very soft brush. Spray or brush on one of the following solutions:

Shellac in alcohol (dilute) or else resin.
*Rice, maize, tapioca or starch water.
*Dilute glue-size (2% solution).
*Waterglass (sodium silicate).
*Potassium silicate.
Linseed oil, or stearine, or paraffin wax in benzine.
Beeswax in turpentine.
*Fish-glue or seccotine in water.

In general, dilute sufficiently to permit of easy impregnation. Those substances marked with an asterisk are water-soluble, and to be avoided if there is any possibility of damp atmosphere or water of crystallisation preventing their setting. Aqueous solutions must not be used for water-soluble objects such as unbaked clay, for obvious reasons, nor should they be soaked in water.

Earthenware

Pottery, etc., need never be reconstructed in the field. It must be packed carefully in such a way that the edges are not chipped. On prehistoric sites every scrap of pottery must be collected. In addition to marking the level at which it was found, mark the fragments, even those collected on the surface,

with their appropriate grid-marks. Note carefully the strata from which pottery is absent.

I have frequently found that adjacent potsherds have been affected by very different chemical agencies, humous acids, organic acids from Hyrax urine, and so on. If these are not marked as having been found together they prove puzzling. If two fragments are found lying where broken, or when a join is observed, place the two fragments together, and draw a few pencil lines across the join; either a cross, one, two, or three parallel lines, will permit easy recognition later when reconstruction is undertaken.

In the laboratory a pair of sherds are stuck together and placed to dry in a sandbath. Cellulo-acetone solution works well, a ropey shellac solution in alcohol, etc. If there is efflorescence of crystals, steep the potsherds in changes of water, and dry thoroughly before repair. All dust must be removed from the surface of the join. Avoid aqueous cements, except plaster of Paris and glue. Various waxlike cements can be obtained commercially, but usually need heat. These are seldom efficient unless the potsherds are heated as well, which may induce crackle, scaling, etc.

I find that the best method of using a sandbath is to have several flat trays, two inches deep, filled with clean sea or river sand. In joining a pair of sherds, the larger one is inserted in the sand, and the smaller fragment balanced on it, so that the slight pressure helps the join. Clean off excess glue or cement.

If sherds are missing, do not reconstruct unless the pot is considerably weakened. It is better to reconstruct half a pot and show that face to the public, than to reconstruct the whole, as there is considerable evidence to be obtained from the broken edges of pottery. Take a sheet of paraffin wax (dental wax is excellent) and warm to blood-heat in the pocket. Mould slightly with the ball of the thumb to approximate to the curve of the pot, press this on to the face of the pot to cover the hole from the outside. Turn the pot so that the weight rests on the wax, supported in the sandbath. Damp the edges of the pottery, and fill the cavity with plaster of Paris. Remove wax, and colour appropriately.

Struts are often necessary in large pots. These can be made of fencing wire, with the ends bent to give a proper hold.

Wet the inside of the pot where the stay will rest, mix plaster of Paris and size-water to a creamy consistency, and build this up on the pot surface, insert stay while plaster is wet, and cover the ends of the stay. The size-water slows down the setting time. The plaster will colour slightly with rust from the wire, but action soon ceases.

For small patches I have found a paste of plaster of Paris, glue-size water, red ochre, burnt umber or other earth colours, and fine clean sand quite useful. This is mixed to a consistency slightly thinner than modelling clay and pressed well home into surface cracks. The colour must be darker than that finally wanted, as it dries lighter.

To ensure that the final join will fit, a technique used in reconstructing skulls can well be applied to pottery. One difficulty in repairing spherical objects is to maintain the exact curve; the space taken up by glue, particles of sand or pot, slight distortions in setting, and so on, all accumulate, and even a quarter of an inch of error in a circle a foot in diameter is difficult to avoid. After good joins have been made between several pieces to reduce the number of fragments, pieces of celluloid about an inch wide and two or three inches long are attached to adjacent pieces on the inner surface with cellulo-acetone. These hold the sherds correctly in position, but the join is slightly flexible. This is continued until the pot has been reconstructed into two large portions which can be adjusted to each other. If the join agrees, each crack has a one-in-ten solution of cellulo-acetone painted into the crack, and the whole pot is left in the sandbath to dry.

In repair work pressure is often needed. I have found spring clothes-pegs useful in many cases. Balancing in a sandbath, leaning weights against objects, placing weights on top, are all helpful. In the case of a completed pot it is often useful to bind the pot carefully with bandages to ensure even pressure. If this is done, sheet cellophane should be placed between the bandages and the glue. This will strip off cleanly after the cement has dried, even in the case of cellulo-acetone.

A little personal experiment noting consistency, time of setting, contraction, reaction to efflorescence, dust and damp, and eventual strength, will teach more than a dozen handbooks.

Remember that cements, especially acetone, dry out on the surface first. Allow sufficient time for the centre to harden.

The Study of Potsherds

Before any reconstruction is undertaken, note carefully the following points concerning potsherds:

(i) Type of fracture usual. If this is "bonded" like a brick wall, so that sherds lie generally horizontally, look for clean breaks that reveal a weakness of join in the original clay pot. These will be found smoother than normal fractures, and reveal that the pot was originally made in rings or spirals of clay, pressed together at the joins. These can be followed round the pot, and the structure noted.

(ii) Type of inclusions. All pottery contains some bonding material or inclusion, whose function it is to regulate and control the contraction of the drying clay, and the expansion under heat. In South African Smithfield pottery grass is always added, while in the "Hottentot" types, powdered quartz or quartz sand is added. In most Bantu pottery powdered potsherd is added to the unburnt modelling clay, and is therefore generally invisible when the whole is burnt.

(iii) Use of a wash, slip, glaze, etc. Often the coarse clay of the body is washed over with a fine slip of thin, smooth clay. This is generally observable in the broken sherd. A graphite polish may be used.

(iv) Unevenness of baking, pastry-like layers of clay, and so on, should all be noted.

In general, if a pot must be reconstructed for show purposes, leave a few clean sections of broken edges for the expert to examine; these can form the back of the pot in the show-case, and any loose sherds can be kept inside the pot to which they belong.

Silication

The use of sodium silicate (waterglass) or potassium silicate is advocated in Europe. Dr. Marcel Baudouin has perfected his own field methods, sometimes with interesting results. I have

experimented with waterglass, but have had no good results. I have not experimented with potassium silicate, which Baudouin regards as the more effective medium.

Silication can be undertaken either to consolidate special parts of an excavation, even an entire burial, or to strengthen fragile bones, etc. Baudouin isolates a grave by means of a small trench, an inch or so wide, and as deep as the grave. A quantity of potassium silicate dissolved in an equal amount of water is carefully and evenly poured over this isolated block. When absorbed, a second bath is given, and so on until no more is taken in by the soil. This should set in an hour or two, and can then be removed as a solid block by undercutting. It is carefully packed, and kept right side up. Excavation can now be undertaken under "laboratory conditions", or the whole can be displayed in a show-case. I do not know whether any marked efflorescence takes place.

Individual friable objects may be painted with the potassium silicate and water an hour or two before detachment from the soil.

Encasement

Dr. L. S. B. Leakey has developed a method for the extraction of complete graves without interfering with soil structure. The grave is isolated as a small island, then wrapped with surgical bandages, hessian, muslin, etc., dipped in plaster of Paris mixed with slight excess of water (the excess will be absorbed by the soil). Once this has set, slight undercutting of the grave is started. Muslin strips are built into the undercut as it is made, and the process is continued until the grave is quite enclosed in a plaster coffin. Reinforcements of hessian are built in as a cradle to prevent the weight of the grave soil from breaking through the bottom of the coffin. The top of the coffin is closed with a sheet of cellophane, over which plaster may be safely poured. The specimen so treated by Leakey arrived safely at the Royal College of Surgeons, where I was permitted to see it. The process needs considerable thought and care, with a thorough knowledge of the action of plaster of Paris. It is only to be undertaken in cases where the interment is of extreme scientific value.

Preservation of Paintings

Methods for preserving prehistoric paintings have yet to be discovered. Under "Primitive art sites" I gave some of the agencies affecting the permanence of paintings. These should be studied, and efflorescence under certain museum conditions should be added. I have seen attempts to preserve paintings with shellac, or with linseed oils, etc. They have all been remarkably efficient in their complete destruction of all trace of paintings. In the case of any "preservative" in which linseed oil is used, the linoleic organic fatty-acids tend to oxidise with time and to blacken the entire wall. Dryness, easy circulation of air, and preservation from too much direct sunlight all seem to have a helpful effect, but cannot be induced in a dark cave of any depth. I would suppose that the use of certain types of stone-preservative such as are applied to the decaying sandstones of buildings, might prove useful, but this again must be tried out as a long-term experiment on plain rock with similar exposure to the elements before it is applied to paintings.

General

A few books are given in the bibliography that follows; if these are not locally available, most large reference libraries will have appropriate pages photographed or typed out for a small fee. German scientific journals have always published preservatives and formulae, with a variety of methods of application. These must be sought carefully in a number of somewhat inaccessible journals — certainly a task for the Museums Association.

In using any formula, especially one designed for different climatic conditions, try it out on some fragment of useless bone or pottery that has come from a site, and is in a condition comparable to the material that it is intended to preserve. In all museums there are numerous objects that have no records whatsoever. If these have no intrinsic value as rare specimens, etc., they can be used safely for experiment. Records should be kept of the experiment, and at least two examples should be tried out, a dry and a moist, as these react very differently to preservation. At least a year should elapse before any deductions are made. In many cases, it is a good thing to keep three

dated samples, one under dry conditions, one under normal local conditions, the third should be steamed every month or so until visibly damp, and allowed to dry. In my various experiments I have been constantly surprised by the numbers of formulae that do not stand up to local conditions during a normal year. I have also been surprised by the numbers of formulae that could not possibly work (for instance, plaster of Paris made with a saturated solution of alum, which merely sets as a powdery chalk).

Repair and preservation are more important than reconstruction. If a good showcase reconstruction is wanted, do not sacrifice the original. If it will bear either casting or reconstruction, well and good. If not, a wax, clay or plaster model can be made and recast. Such a model should be checked for exact size, surface texture, colour, grain and so on. It can be coloured with matt paints, or appropriately glazed with a shellac or cellulose varnish, while the original is safely kept elsewhere for careful examination by visiting experts. This latter policy is specially suited to ivory, skull fragments and other very friable material.

XIII.

THE SURVEY AND CULTURAL TERMS

So distribution would undo excess.
Lear V. iii.

The methods of survey consist of scientific generalisations from quantities of fact in a carefully limited field of knowledge. The survey may be local, regional or general, depending on the quantity of evidence available and its distribution. A catalogue of sites does not constitute a survey, nor does a series of reproductions of paintings or engravings of varying exactitude. The concept of the survey is essentially that of the reapplication of particular knowledge to a number of comparable cases, in an organised manner, and in such a way that new facts emerge and general laws can be established.

To take a parallel from botany, an investigator may devote time to the study of the habits of a particular plant in a localised garden or natural environment. He would deduce certain facts as to its reactions to water, soil, light and general ecology. He might then turn to the survey method and plot the exact distribution of the plant over the whole sub-continent. This catalogue in itself would yield him little new. He must take into account the general geographic background, the particular ecology of each area, the soils, rain, altitude and prevalent winds. This brings his catalogue into correct perspective. It is the study of these various factors in their relation to a single distribution that turns the catalogue into a survey. The botanist's new findings will include confirmation or review of his original findings, but they will considerably augment his knowledge of the conditions the plant can survive, what factors will lead to the development of new varieties, their points of origin and the channels of distribution. He must make use of all sorts of data in his survey. It may be a simple study of a single species and its varieties; or he may study a whole genus, comparing the differential distribution of species in relation to the genus as a whole. It

may be a study of two apparently unrelated plants, comparable through the common factor of identical distribution. He might study a particular group of plants, the relation of succulents to environment, or of plants with tap-roots, or the distribution of unallied deciduous plants.

The point of the survey is that it must be planned, depending for its orientation upon knowledge already acquired from defined and limited study. It must have direction, and all factors that do not help towards this end should be set aside. Whatever concerns the survey must be isolated, and limited to the minimum of essential information that can be efficiently and accurately obtained through agents (many of whom are amateurs), without the destruction of other evidence.

The fundamental *sine qua non* is that material should be comparable. It must conform to the rules laid down for any other statistical data. The distribution of paintings is of little use, but once this is analysed, and we can study the distribution of such elements as the paintings of hands, or the pecking of human and animal footprints into the rock, we can get somewhere.

The finest study available in the archaeological field is Cyril Fox's *The Personality of Britain*. For a detailed study of the factors that may be involved in determining the distribution of human cultures, there is Kroeber's *Cultural and Natural Areas of Native North America*.

Cultural Determinants

Just as the botanist studies ecological determinants, so the prehistorian or the ethnologist will study the appropriate cultural determinants in order to isolate those factors that have governed the origins and distribution of his elements. In prehistory they are of primary consequence, more especially as within certain limits, they are varying factors in the course of time, and in relation to different ways of life. While it is impossible to deal very fully with these determinants here, we may well enumerate a few, especially in so far as they are likely to affect the study of prehistory.

1. Mode of life and sources of subsistence. With a hunting and collecting people this is based upon immediate environmental factors, as these existed at the period under consideration.
2. Social organisation. Little can be learnt of this, but it is generally related to population, to the abundance and concentration of sources of food and water, to rainfall and soil fertility.
3. Cultural tradition, habitual tools and techniques, habitual sources of material culture. As men become more and more expert in the use of these, the harder it is to break with tradition and learn the uses of new tools and new materials. If the tradition is forcibly broken, artistic ability inevitably deteriorates.
4. Cultural contacts with surrounding people. These have always augmented culture, and have sometimes succeeded in changing the entire mode of life of a people, by trade or conquest.
5. General environmental factors, effective height of mountains, barriers to movement, areas of attraction, etc. The presence of generally available materials and foods.
6. Particular environmental factors. The presence of shellfish, vertebrate fish, sea-birds, mother o' pearl, the abundance of special materials for implements (obsidian, indurated shale, flint), with a local distribution. These highly important factors will vary from one area to another, and may force different stresses and accentuations within a culture, changing its superficial aspect.
7. The need for specialised tools for working particular materials. Abundant forests may enforce the use of abundant wood-working tools. Needs will vary in different areas, independently of culture, changing the expected assemblage at particular sites.

The list might be extended, but the point is that in a survey, whether local or general, geographical distribution is in itself valueless. Cognisance must be taken of altitude, distribution of rainfall, prevalent winds, the localisation of fauna and flora, types of animal pasture, forests, the proximity of the coastline,

the presence of particular elements (additional to those that might be expected in almost any environment) such as fertile mountain kloofs, natural highways, forests, permanent water, and so on. Endemic diseases may have an effect, nagana, malaria, local diseases affecting animals or plants; the fundamental absence or abundance of essential foods, such as salt, calcium, iodine, or green foods, all have local effects.

Many of these factors are difficult to assess, and perhaps only a few may be found of value in enlightening or explaining a particular distribution, but all have to be watched. The map is merely an epitome of the card-index used in the survey, and cannot be an end in itself. It provides the basis for comparison with the distribution of factors given above, and may be made to yield migrationary routes. Crawford's book is the best introduction to survey methods that I know.

To take an instance where the prehistorian and the physical anthropologist might fruitfully combine: it is obvious that our coastal peoples had a diet rich in lime, fluorine, salt, iodine, etc. Abundant edible sea-weeds were present, and were eaten either direct, or more probably predigested from shellfish. East of the main mountain range of the Drakensberg the living conditions must at all times have been good; west of those mountains conditions must have been increasingly bad the further west man lived. It should therefore be possible to undertake a basic survey of all known skeletal remains from the Later Stone Age and from the protohistoric period, with a view to discovering whether or not there was any relationship between culture, feeding conditions and general health.

General health should show itself in relative stature, robustness, paedomorphism, age at death, and the presence or absence of malnutrition in the formation of bones and skull. Cultural richness is more difficult to assess, but the number of painted or engraved sites, or the numbers of bored stones per square mile, might supply some general basis for comparison. The presence of particular cultural elements, an increase of bone implements or of pottery in particular areas, might have to be brought into the picture; it is these special cultural efflorescences, in contrast to the general, that mark off a strong from a weak culture. Much of the data is already available, and such a

survey might prove helpful in locating material in private collections not at present available to science. All that is essential is the planning of the survey, so that material collected should be directly and absolutely comparable. So far there have been many generalisations as to the relative tallness of coastal peoples, the richness of cultures at the coast, the acceptability of paedomorphism as a racial characteristic, and so on, but little has ever been adduced in proof.

Terms of Reference

A survey needs agreement upon aims and essentials. All extraneous evidence should be discarded and set aside for use in some later survey. Thus in the questions raised above, racial type would probably be of little interest, as the effects of malnutrition and the abundance of essential foods are probably unrelated to race. In studying the distribution of game, the spread of a particular grass (unless it is symptomatic of a particular type of veld) is not important, as it could generally be replaced efficiently as food by another grass. On the other hand, winter and summer grazing are important, as they once controlled game migrations.

An overwide broadening of terms is useless. The distribution of a particular isolated animal does not give a clue to environment. A general and comprehensive picture of the totality of fauna is needed. In the same way large numbers of figures relative to man are essential to convey a true picture. Migrant individuals, vagrants from neighbouring areas, chance travellers, will not prove anything. In dealing with men or animals sampling is unsafe; the only possible sample would include all available material. This may mean that our areas would have to be wide, related to the broadest possible environmental basis, and large enough to yield adequate samples. If an area is unknown it is essential to mark it "unknown," not fill it in with a wide wash of colour. The extrapolation of distribution points and migrational routes must be fully reasoned, and those reasons given. In all distribution, negative evidence is as important as positive, and may in certain instances be made to yield even more valuable conclusions. Whatever our deductions from a survey may be they are never final. In a changing world and with increasing data no survey is ever complete or completed.

Institution of New Cultures

This question is best dealt with in relation to the survey. It is important, as it is the basis of our terminology. There will always be some difficulty in agreeing upon what should constitute a new "culture" in this terminological sense. A directed knowledge of existing simple cultures is fundamental. They should be approached ethnologically, and viewed with an eye to the factors determining culture. Deduction should then be reapplied to the prehistoric field. This is not a matter of "comparing" primitive man as he exists to-day with the simple folk of prehistoric times; study should be directed to finding the fundamental impositions that Necessity places upon people who depend directly upon the fickleness of Nature. Kroeber's and Daryll Forde's text-books are by far the best sources for such laws. From general study it will be seen that:

1. Culture may show important differences in form and distribution in winter and summer. This is most intense where the climatic swing is most marked, but it is an unvarying rule among people directly dependent upon environment. It is generally associable with a somewhat different seasonal distribution of home sites.
2. Areas in which particular and local environmental elements are important show specialised tools and cultural habits, often preponderating over those more general cultural elements typical of a people as a whole. For instance the use of the blow-pipe for hunting in areas of intense tropical forest, in contrast to the bow and the spear in more open grassland; or the abundance of bone tools where large sea-birds are easily available.
3. A local balance of vegetable foods in relation to meat food will affect the accentuation and ratios of cultural elements and the types of tool used.
4. It has been shown elsewhere that quarry, factory and home sites each reflect different aspects of the same culture, and tools typical of a factory site may be absent at a home site of the same culture.
5. Local plenty will bring leisure, which in turn is evident in the development of materials and increased versatility and inventiveness, producing a "strong" culture.

6. Apparent plenty may not yield a higher density of population; in a forest environment vegetable foods are plentiful, but protein in the form of flesh is rare, and may have to be substituted for by cannibalism. In contrast Darwin (*Voyage of a Naturalist,* Chap. V) points out that the largest edible mammals seem to thrive naturally in areas of sparse vegetation.
7. We are not dealing with purely biological species; we are dealing with man, blessed with adaptability, cursed by a free will and encumbered by a cultural tradition, and therefore able to make advantageous use of his local environment within certain marked limits, and to mould either himself or his environment to his immediate ends.

There is only one logical conclusion to be drawn from all this. Cultures must be defined on a wide comparative basis. In our own society it would be ridiculous to speak of a Fisherman Culture, a Citizen Culture or a Farmer Culture; all are environmental or professional aspects of the same complex. It is those elements that are *shared in common, not the differences* in sources of food supply, raw materials, or in immediate outlook that count. *The whole,* bound together by those common elements to form a single entity, constitutes the basis of a culture.

This use of elements held in common as a basis for the institution of new cultures implies a wide knowledge of a number of sites. None of the cultures (except at that time the Fauresmith) submitted by me to the Conference of 1926 and accepted there depended upon my knowledge of material from less than a dozen sites. The definitions included those elements held in common, not those that then seemed to have a sporadic and local distribution. In 1928, when I instituted the Middle Stone Age, the foundations were much the same, but here I first used the term "variation" consistently to cover all the new cultural terms defined. Later, when I raised certain of these to a "cultural status", the term Variation was kept for those of which I still had insufficient comparative knowledge.

The fundamental criteria for the acceptance of a new culture should therefore be:

1. Comparative knowledge of implement types from a number of sites. The better those sites, the fewer will be essential to constitute a solid foundation.
2. A detailed knowledge of stratification and variability at one or more of the sites. The most typical of these should be selected as the name-site.
3. Description and definition of the culture in terms of the basic tools, techniques, and other elements held in common that are representative of the new culture, and of no other.
4. Description of unusual elements as observed at the individual sites, demonstrating the range that can be expected within the culture. These can sometimes be related to local factors of abundance, etc.
5. Elimination of any possibility that only atypical sites are being described (e.g., quarry sites, coastal sites, etc.).

The acceptance of a culture as an addition to terminology should therefore depend upon the survey approach applied to perhaps a dozen sites, and over a reasonably wide area. Cultures are not biological products; we cannot hope to define their efflorescence, scope and variability on the evidence of a single site.

Wherever possible stratigraphical evidence should be obtained, but in a summer-rainfall area this is not easily done, and statistical evidence of the type outlined elsewhere should be permissible in cases where a pure cultural assemblage can be isolated, and where the number of specimens is sufficient to be regarded as truly representative of the culture, and enough for statistical purposes.

The typescript is best submitted to a minimum of three referees who are well acquainted with the prehistoric field; men of standing with a wide comparative knowledge. Only after some agreement on their part should such a paper be sent to a society or public body for publication. It is important too that the paper should appear under the name of the author as his considered opinion, not as a "report" from some committee consisting of men with a partial and localised knowledge. Their work should follow the initial publication, expanding or criticising the paper from individual experience.

The best arrangement for publication would probably be similar to that given later for the publication of the survey, with slight adaptation.

(i) Intention.
(ii) Geography, environment and superficial geology of the area studied, including a simplified map with sites and major barriers and attractions marked.
(iii) Study of previous literature and museum material.
(iv) General circumstances of discovery, known distribution.
(v) Enunciation of cultural elements held in common.
(vi) Particular sites, defining special variants, characteristics and expected range of the culture. Associations.
(vii) Chronological proofs, stratigraphy, physical condition, relationship to other cultures.
(viii) General summary of conclusions.
(ix) Bibliography of references.

Cultural Terminology

There must be agreement on the system of terminology appropriate to cultures. In Europe the double system employed seems to work well. Prehistoric cultures are named after sites from where early material was described. Protohistoric cultures are named after the people (Gauls, Celts, Anglo-Saxons, etc.) with whom they are associable. This system is reasonable and applicable in Africa, where prehistoric cultures are generally named after African place-names, and protohistoric cultures are named tribally. No other terminology should be permissible. This general principle was accepted at the 1926 conference.

Terms such as "Strandloper Culture," "Kitchen-midden Culture," have been avoided as misleading, as each covers a number or cultural groups. In the same way "Pebble Culture," which might be applied equally well to the earliest prehistoric, and the most recent midden cultures, is misleading and meaningless. The use of racial terms ("Boskop Culture," etc.) must be avoided, as this depends on the presumption that only one culture can be associated with this race, and only one race with that culture. We can of course use indeterminate labels such

as a strandloper culture, a pebble culture and so on. It is the specific terminological use of these titles that must be avoided.

Finally, once a cultural term has achieved general acceptance and has been in habitual use in publications, lectures, museum catalogues and descriptions over a period of years, it is important that every effort should be made to retain it. Even if subsequent research shows that the original classic site is atypical, the commonly understood term should be kept and continuity maintained. Continuity is of greater importance than apparent exactitude, more especially as any change in terminology leads others to invent and prefer their own peculiar synonyms. In Africa the use of regional terminology (e.g., Smithfield N, Smithfield P, Kenya Still Bay, etc.) has prepared the way for a far more exact approximation of terms to local facts and facies than is possible in Europe.

XIV.

PUBLICATION

I have misused the King's press damnably.
I Hen. IV. IV. ii.

In South Africa our greatest danger lies in the tendency to reduce scientific publication to a standard usually kept elsewhere for popular journalism. Journalism has an important place and supplies an extremely useful means of publishing news, views, snap-judgments and popular articles that merit twenty-four hours of interest. The scientific article is a very different proposition. It would be a pity to muddle their functions. There is a saying that an article is out of date directly it is printed. This is only true in so far as the fact of publishing makes it available and assimilable. It can be brought into line with the experiences of the reader to create part of a newer pattern of knowledge. As a scientific record no article is out of date until the "factual" basis is proved to be biased or false. The failure of a theory to hold the field should not affect the facts. A scientific paper should therefore be drawn up in a form that merits permanency.

Much that is published under the imprimature of our scientific societies should never have seen publication: most of the material published *in extenso* would have benefited from cutting, publication of a précis, or complete rewriting. Every writer should carefully consider the merits of the material, his own ability to produce a useful scientific paper, and the form in which it can most suitably appear. He should ask himself these questions:

Does the material merit full publication? If it is merely a reduplication of previous evidence, then it does not. If it only augments the factual evidence, or increases the knowledge of the distribution already known, then all that may be needed is a short note to that effect.

Am I capable of producing a scientific paper on this subject? If the answer is, No, that is a matter than can be rectified. There are four essentials: mature consideration of the material and circumstances in the light of previous training; a careful study of all the appropriate literature; a detailed comparison of the new material with comparable series in the nearest museum, and from neighbouring sites; and finally complete reconsideration in the light of the knowledge now acquired.

I consider that two to five years of deliberation, research, reading and comparison is the minimum necessary to study a new and major problem. For simpler problems, the description of a site, etc., a year of digestion, constant handling of the material and comparable series, is needed. If this is true after a University training, twenty years of research, the presence of the most complete libraries in the country, the best comparative series of overseas implements, and the whole of the South African Museum at my disposal, how much more is it true under less favourable conditions?

In what form should publication appear? There are various ways to publish a serious paper, and I shall enumerate them in the order in which they should be considered.

I. Typescript report or thesis. In every case notes should be written up as completely as possible, typed out with sufficient carbon copies, and sent off to the nearest museum, to the Archaeological Survey, and to any other interested persons and institutions. The original typescript should remain with the collection. Be as detailed as you wish, draw what conclusions the material merits, and give reasons; provide as complete a series of sections, plans, maps, and photographs as is necessary. Do not stint yourself, as this is part of the process of digestion. Frequent returns should be made to the site while writing up the work.

In a covering letter ask for criticism, and be willing to consider it. State whether publication is eventually intended, whether the recipients are permitted to make use (with acknowledgment) of the typescript and illustrations, and where the original material may be seen. If possible, accompany the museum and the Survey copies with a series (either on loan or as an

acquisition) of representative implements such as would illustrate your conclusions. The specimens reproduced as illustrations should be retained, but proper arrangements should be made for their eventual safety and preservation. They should be numbered in waterproof ink, and preferably presented with the bulk of the collection to an appropriate body. In my opinion this should be the nearest museum, in order to facilitate access by local workers. Measurements of all outstanding examples should of course accompany the typescript.

Whatever the circumstances, whether publication is eventually desirable or not, the practice of producing a preliminary typescript, or of sending duplicate copies of notes from a quarto carbon book, should be fundamental.

In arranging the typescript a good general plan is as follows:

(i) Description and location of site.
(ii) Circumstances of finding, stratigraphy, physical condition.
(iii) Description of material in detail.
(iv) Comparisons, with references to material compared.
(v) Expert reports on skulls, pottery, fauna, flora, soils, etc.
(vi) Deductions and conclusions.
(vii) Short précis suitable for separate publication, 200 words.
(viii) Bibliographical references, thus for papers: Year. Author. Title. Journal. Volume. Page. Or thus for books: Year. Author. Title. Publisher. City. Page.

Typescript thesis should be the normal channel for the publication of student symposia and M.A. theses.

II. Publication by note or précis. This consists of the publication of item (vi) above, or a slightly longer summary. It will cover items (i), (ii), (iii) and (vi), each in a much shortened form. Description of material need only be by comparison, thus "Typical Smithfield B. assemblage, recalling material from (site) described in (bibliographical reference)". This is all that will be generally necessary in the case of a minor find that augments knowledge of distribution, but does not affect the typology or stratigraphy of known cultural groups. (250 words).

III. Publication by survey. Remarks on the concept of the survey are given elsewhere, but material from a single district, a single catchment area, or a stretch of coast can be made to form a very useful and instructive local survey. It should give a lucid account of a consistent area known sufficiently thoroughly to ensure that new facts particular to the area as a whole can be deduced. Particular material, the general environment, and special environmental elements should all be made use of in the study. Here a slightly different plan is merited:

(i) Intention of the survey.
(ii) Geography, environment and superficial geology of the area, including simplified map with sites marked.
(iii) Study of previous literature and museum material.
(iv) General circumstances of discovery.
(v) Particular sites (in probable chronological order) in fair detail, with minimum of repetition of description.
(vi) Chronological proofs, stratigraphy, physical condition, etc.
(vii) Expert reports on fauna, flora, skulls, pottery, soils, etc.
(viii) General summary of conclusion, 400 words maximum.
(ix) Bibliography as above.

The survey approach must eventually take the place of the description of single sites. There is far too much repetition of detail, illustration, etc., in the present method of publication. It also opens the way to youthful (and other) dilettantes with a sudden urge for publicity. The use of the survey means that more weight will be given to the work of local enthusiasts with a long history of study behind them. It may be possible by agreement to include material by one or two workers in a single area, under an editor, and to make use of appropriate typescript reports, with acknowledgment. These should be filed.

IV. Publication *in extenso.* This is seldom necessary. Of perhaps a hundred sites that I have discovered, only a dozen or so have merited full publication; the remainder are touched upon in general papers, surveys, etc. Full publication should mean a complete redigestion of the typescript thesis, after every effort has been made to assimilate and check local literature and previous finds, and bring these to bear on the problems to hand. A return should be made to the site, even if only for a day, to

give final touches to the manuscript. Be careful to confine yourself to the matter in hand, do not ramble, and do not draw conclusions that your evidence does not merit.

> Conjecture, expectation,
> And surmise of aids uncertain,
> Should not be admitted.
> *II. Henry IV.* I. iii.

Preparation for Publication

After thorough correction, manuscript should be typed out in double spacing, preferably on foolscap, with a carbon copy. An estimate of length, to the nearest 50 words should be pencilled on the outside of the cover; if it is book length, the nearest 500 words. Typescript can be given to a competent typist or agency, and the corrections made on this typescript must be final. If corrections are numerous, retype the offending page. No addition or change should be necessary when you receive your proofs from the printer. This is sent you to check misunderstandings on the part of the printer, and most societies will charge you with additions or excisions made at this stage, unless they are asked for by the editor. Return proofs as soon as corrected. Good sample proofs can be seen in Pears' Cyclopaedia, and trade rules should be followed. Most printers of repute have "house rules" for punctuation, and for spelling such words as artefact, waggon, recognize, etc. Permit these unless you have real reason to the contrary.

Black and White Illustrations

The intention in making a drawing is to give a clear illustration that will truly represent the implements concerned, and be understandable. Apart from the simple drawing of a series of accurate lines, the illustration should show the position and direction of every cleavage, and at the same time should represent the thickness of the tool. Lighting should be consistently top left. Learn the use of a fine drawing pen, also a draughtsman's pen for ruling borders, etc. Choose good models, e.g. Mrs. Leakey, Mrs. Burkitt, and most French illustrators. Use waterproof black ink on Watman's smooth-surfaced boards, Bristol board, ivory board, or a hand-laid parchment paper. Ivory board tends to yellow if aged in the light.

Sections, maps, line-drawings and photographs must be planned to suit the format (proportions) of the journal, checked from a previous number. They should never exceed a single page each, unless very special circumstances demand it. Figures in the text should be designed to fit the width of the letterpress, and take a third of the height. Everything should be submitted on such a scale as to permit reduction to page width, one-half linear (quarter size), or three-quarters linear. A scale in centimetres and inches should be drawn on each figure, as it is ambiguous to add remarks such as "half natural size" to the caption. Notes to the printer should be added in blue pencil: "Reduce to page-size", "insert fig. 5 here", etc. If a half-tone is essential, it can be added as a clear flat-wash of blue drawing ink slightly diluted. This is reproduced mechanically as a shading of fine-screen dots by the blockmaker.

Preparation of Photographs

These are expensive to reproduce, so reduce the number to a minimum. They must be submitted as enlargements on contrasty glossy paper. Any chemist will arrange to have this done for reproduction. Thick paper is best, but never attempt to mount a glossy photograph yourself. Titling should be on a separate slip of typewritten paper, gummed loosely on the back of the print. Never write on the back of glossy photographic prints or use paper clips: both will show through the delicate gelatine film. Place each print into a separate cellophane or transparent envelope to avoid damage from handling. Pack the whole between stiff cardboards before posting.

In photographing implements the best plan is to use a flat sheet of glass, bearing the implements and a scale. The glass is placed horizontally about 2 feet above the ground, and a sheet of white cardboard is placed below at such an angle as to cast reflected light upwards. This gives a plain background without shadows, and removes the need for cutting out single prints and rearranging them, a method that is never effective. The camera is now placed over the centre of the glass, at a height of one, two, or three feet, and screwed firmly on to an upright; a stepladder is suitable. The focus is carefully gauged, or adjusted with the ground-glass focusing device, and a

time exposure with a small stop is taken. If implements vary considerably in height, raise the flatter ones to the same plane as the higher by using plasticine, etc. Great care should be taken of the lighting of the surface of the implements. Lighting should be mainly from one direction, but lightly reflected back, so that while contrast is sufficient to see every flake-scar, it is not sufficient to black-out the shaded half of the implement. White quartz is extremely difficult to photograph well; under-exposure helps.

Touching up must be confined to the negative. It may consist in differential development to bring out dark corners of a cave, the addition of arrows, lines to show stratification, etc. Red or black waterproof ink used carefully on the gelatine face of the film or plate will print white on the positive, and should be drawn against a light. Most good photographs explain themselves and do not need these aids. In touching up, avoid any attempt at "faking", as this will at once cast doubt on all your work.

Rock-engravings, carvings, etc., should always be photographed with a consistent top-lighting. If this is not done the sunken lines will often stand out as ridges on the rock-face in the reproduction. A glance at Zelizko's reproductions will make this clear. On a site this is not always possible as it depends on the position of the sun. In such a case try to photograph the specimen while the sun is behind a cloud, and reduce the contrast by that means, or use a white reflector and shade the face of the engraving.

Contents and Index

A contents table is quite unnecessary for a paper less than 150 pages in length if proper headings are used. An index is only necessary in works of over 200 pages, unless special circumstances make its use essential. In most cases a straight list of sites will cover the needs of an index, but where this is not enough, it should be compiled with the help of a trained library assistant and a small size of index card. Cheap visiting cards, 2″ x 3″, will serve. The heading is adjusted in correct index style (with the noun as the first word in most cases) and written in ink on the card. The typescript page is added in pencil. No

notice is taken of the galley-proof, but a page-proof must be asked for, and the corrected references to the printed page marked in ink on the cards. The index is now typed, and sent back with the page-proofs.

Submission of Manuscript

Scientific papers are published on a communal, non-profit basis. Societies depend for their income on subscriptions, government grants, and rare and meagre gifts and endowments, and are generally without excess funds. A limited amount of publication is possible in each year, and the selection of one manuscript may prevent or retard the acceptance of others. Museums generally give preference to their own staff, paid or honorary, and will accept outside contributions provided that material in the museum is described, or that the major portion of the collection is presented to the museum. Museums prefer descriptive work to theoretical.

The following bodies issue publications on prehistory, and it would benefit the future of our subject if publication were limited to them:

Albany Museum, Grahamstown.

Archaeological Survey, Witwatersrand University, Johannesburg.

Argeologiese Navorsing, National Museum, Bloemfontein.

South African Archaeological Society, Sherwood, Sherwood Avenue, Kenilworth, Cape.

Royal Society of South Africa, University of Cape Town, Rondebosch.

S.A. Association for the Advancement of Science, Kelvin House, Johannesburg.

S.A. Geological Society, Kelvin House, Johannesburg.

South African Museum, Cape Town.

Transvaal Museum, Pretoria.

The Royal Society of South Africa, the South African Museum, the Geological Society, and the Archaeological Survey expect a high standard, based upon long experience and thorough knowledge. In general all societies expect that contributors be

members. As many papers cost between £60 and £100 of the society's funds, the sacrifice of a guinea or two per annum is not too much to ask. Most museums are keen to get the help of trained workers in a purely honorary capacity, for help in sorting, cataloguing and the general arranging of museum and school display cases, and for expert advice. In return they are in a position to help publication, provide facilities for comparison and identification, and for preserving and reproducing valuable specimens, and to introduce helpers to workers in other fields. They are sometimes able to lend essential transport, labour and camp equipment for field work, or to combine one of their own collecting expeditions with an archaeological excursion.

Acceptance of Publication

Any society or museum will submit a paper to at least two referees for their judgment. They act anonymously and send a full report to the editor. They will either refuse, accept, or demand some re-editing of a paper. This last is the usual judgment. It involves no disgrace, and should therefore not be met petulantly. It is intended to help the writer and to give him expert advice. If the paper is to cost the society a considerable sum, it devolves upon the writer to spend a comparable amount of trouble in producing a worthy piece of work. The return of a paper is often an excellent safeguard against foolish mistakes, as any paper will be read in a different light after it has been out of the writer's hands for a month or two.

Copyright

The copyright of a paper is partially ceded to the scientific body that finances publication, and if portions of an article, or illustrations are to be republished, it is courteous to ask permission. Most scientific bodies will permit an author the use of actual blocks at reduced prices. If a third person asks for the use of the blocks, this cannot be granted without the permission of the author. If generalisations or conclusions are drawn from a scientific article, every writer has the right to expect full acknowledgement, including a bibliographical reference; the same is obviously true of quotation.

In law the copyright in photographs, publications and collections belongs to the one who does the work, unless the work is done to the order (specific or general) of some other person for a valuable consideration. This would certainly include an employer, either University or Museum, that considered research as a part of employment. Most institutions willingly permit the products of work done at their expense to remain in the hands of the employee during his term of employment, but they should eventually revert to the employing body without payment or the need for any stipulation in a will. Such photographs, implements and field notes do in fact belong to the employer, wherever they may be housed. In practice the legal aspect hardly arises except in the case of collections. Private collections made by private persons would not normally be affected by this, if they are made at the expense of the collector. In all these questions it is the subject that must eventually benefit, not the worker, nor the museum.

The whole legal position of copyright, and of other associable rights, is a difficult one. These matters are generally a question of custom and agreement on a basis of equity, and the exigencies of the case have also to be considered. It is obvious that the positions of the private enthusiast and the paid worker are very different. I would regard it as dishonest for a paid worker to make a private and personal collection of implements, skulls, etc., or to expropriate exchange publications presented to him in an official capacity. It is therefore only right that reprints of importance should be sent both to an institution and to the worker personally. Groups of objects may often be kept under his charge and in his possession for the period of his employment, but they should pass quite automatically to the body that employs him for the specific purpose of increasing its knowledge and collections. This rule cannot of course apply to books or periodicals bought by the individual for the purposes of his work out of his salary or private funds.

The question of the amateur receiving a grant for specific work is similar, and it can be accepted that whatever kit, publications and other essentials (not considered as consumable) are listed in his accounts, belong to the body making the specific

grant, and should be at its disposition. The same is true of negatives, etc., though no reasonable body would cavil at the private sale of prints to newspapers or other periodicals, provided that acknowledgement is given.

The Present Series

The policy of the Society at present is to publish two separate series, each current number of which is available to every full Member free. The Handbook series (of which this is the first) is meant to give a general and accurate survey of prehistoric archaeology in South Africa in terms that are not too technical and erudite for an educated person to assimilate and enjoy. The other series, published as the Bulletin, is intended to give informative and popular articles of a general nature, written simply, by a variety of experts in particular fields.

It may eventually be possible for us to publish monographs of a more technical character in one of these two series, but at present we are primarily interested in building up an intelligent appreciation of our subject among thinking men and women. It is our immediate task to create a public, and to supply people with the necessary introduction to the many possibilities of an enthralling and versatile hobby.

XV.

NECESSARY OUTFIT

Are these things then necessities?
Then let us meet them like necessities.
II. Hen. IV. III. i.

The following list covers all that I have found necessary to meet the very varying needs of field work. In no case do all the needs arise, so I have added the letters O for open sites, C for cave sites, G for general, and S for special uses. This should indicate their scope and usefulness. Even here some knowledge of a site will suggest what is appropriate, and arrangements may be made to hire certain tools from local farmers. Much of the material especially the more expensive instruments can be borrowed from a fellow scientist. They should be thoroughly understood before use, and returned in perfect order.

Aerial Photography. S

The minimum scale of any value is R.F. 1/7,200 (1" to 200 yds.). This usually means flying at 3000 ft. (1,000 m) unless a long focal length is used. Unless an accurate map is to be made, a mosaic with 30% overlap along line of flight, and 20% lateral overlap is all that is needed. Morning or evening light is essential. If a coastal area is taken a knowledge of tides is important. Great care must be taken to define the area accurately, as the process is expensive, and in the hands of a specialist air-photographer who is seldom a prehistorian. The scale suggested will only give the positions of huts, villages, earthworks, terraced agriculture, raised beaches, etc. If greater detail is required, a larger scale must be used.

Alidade and plane-table. O

The plane-table is best made of a drawing board with a central nut capable of attachment to the camera-tripod. An alidade can be made from a school ruler, with short sections of bicycle spoke screwed in for perpendicular sights. With an accurately measured base-line an open sight can be plotted with great accuracy by triangulation. The base-line must be pin-pointed on a large-scale map of the locality. (See Compass.)

Barometer. O

An aneroid with Vernier scale, accurate enough to estimate to ten feet is useful for obtaining gravel levels. Altitude must be checked regularly at a known height (a railway station), and a second height (camp) estimated from the average of readings. Heights should always be noted as plus or minus the camp height above sea-level, and checked each morning and evening. In case of changing barometric pressure constant rechecking is necessary. For accuracy a correction for temperature should be applied. Most altimeters are graduated for an atmosphere at a constant temperature of 50° F., and what we are really measuring is the weight of the column of air between the camp and the observed level. This varies with temperature. The rule is, for each degree of temperature above (below) 50° F. increase (decrease) the indicated height by one five-hundredth. For example, an indicated height of 250 feet in a shade temperature of 90° should be corrected to 270 feet, that is, twenty feet in 250 feet. Finally, translate the heights you obtain to points on a good contour map.

Bars, levers, crowbars, etc. G

Types and forms vary with need. Heavy sleepers, logs or boulders should be used as fulcrums to protect material excavated. Fencing poles, stays or spacers (I- or rail-section) are useful in camp and for excavation, and can generally be borrowed from a farmer.

Blotting paper. S

This or printer's flong or unprinted newspaper may be used to take impressions of deeply cut engravings or carvings. The paper is wet, placed on the rock (which may be slightly oiled) and stumped in with a square-ended brush. Apply further layers soaked in dilute casein or glue size. When completely dry, peel off gently in one piece.

Boxes, collecting. G

Cigarette, cigar or other wooden and metal containers are essential for sorting and packing finds. For larger finds petrol or paraffin, biscuit and other tins are useful. A petrol tin is roughly a cubic foot in content, and generally holds the bones of a small skeleton. Skeleton boxes measuring 24″ x 10″ x 9″ may be made, with the lid as the largest panel. A compartment 9″ from one end will take a skull and jawbones wrapped separately. Use half-inch boards with 1″ ends. Each box must have a ticket inside and a label outside giving details of discovery of contents.

Brushes. C

Rubber-mounted brushes (4″ and 6″ colourwash brushes, a 1″ varnish, and a 1″ square-ended paint-brush) are useful. The first two are for cleaning valuable finds *in situ* before photographing, and for constant excavation. Keep dry. To clean suspend in water over night, when soluble matter sinks. A nail-brush helps to clean stone implements.

Cameras. G

If possible two good cameras of different sizes should be used. A miniature camera taking standard cinema film, kept on a fixed tripod, gives an important one-point view of the development of the work. In addition a quarter-plate focussing camera, taking film-pack or plates, is essential for detailed illustration. The miniature seldom

gives sufficiently perfect detail for enlargement for reproduction, while useful detail from a quarter-plate film can generally be selected for similar enlargement (see Camera tripods).

Camera film and plates. G

I have found slow plates (Ilford Ordinary, etc.) most efficient in shelters and caves. They need long exposure but have far greater latitude and finer grain than any film. They are suited to personal development under camp conditions. A small stop with a long exposure increases detail and definition. A scale should always be evident in the picture. Fast film is best suited to open-air work and to the miniature camera on all occasions.

Camera lenses. G

A good R.R. anastigmatic lens, capable of being focussed to within a yard of the camera, is the absolute minimum for field-work. The greater the adaptability of the camera and the accuracy of the lens, the better. I have found the following lenses useful additions:

Wide-angle (short focal-length)
Narrow-angle (long focal-length)
Filters I and II
Sky-filter for open sites.

Camera tripods. G

A steady tripod is needed for the miniature recording camera. It should only be moved when a new section is commenced. The camera must be heavily protected against dust. Whether a photo a day or a photo an hour will be needed depends on the work, but the intention is to provide a strip of negatives from which a three-dimensional section of the deposit can be reconstructed as a perspective drawing. A constant scale placed at section distance should appear in each photograph. Numbers in series may also be incorporated, but these can be judged from the single strip of film used. A turret-top with a ball and socket joint, or some similar device, is very useful. (See Photographic mirror.)

Candle grease. S

Sometimes useful for dripping on to fragments of basketry, bead-bracelets, etc., to hold them together for development later. Soluble in alcohol or ether. Bees' wax dissolved in turpentine is also useful.

Card-index. G

An alternative or auxiliary to note-books. If a 9″ x 5″ card is used it can be punched to fit a loose-leaf cover. Useful on windy sites.

Chisels, cold. C

One inch, half inch and quarter inch cold chisels are useful, also a centre punch. They can be obtained in car repair outfits. Used for marking grid-squares, etc. on cave walls.

Collecting bags. G

Best made in quantity from good calico. Sew tapes 2 inches down on the outside of each bag for closing. Draw-tapes are too troublesome. Useful sizes are:

15″ x 9″ for skeletons, potsherds, etc.
12″ x 8″ for other large finds.
8″ x 5″ for small bones (hand or foot of skeleton)
6″ x 4″ for small implements.

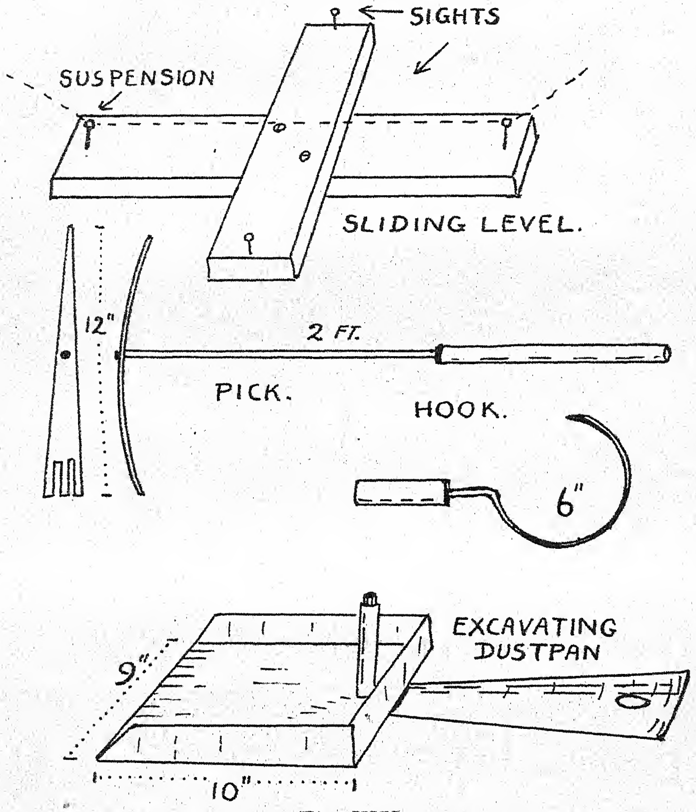

Fig. VIII.
Examples of less usual tools used by prehistorians.

A square of heavily calendered calico can be sewn on for labelling with indelible pencil, but each bag must contain a label, with complete data and note-book reference, in addition to the label for identification outside. Rubberized sponge-bags are useful on open sites in rain.

Colours, oil. G

Tubes of white, black, primary and secondary colours may be used to spot finds from a single layer or site. The implement is touched against the tube mouth and dried. Refer clearly to the colour code in your note-book. Additional white or black household paint is useful to mark fixed gridpoints on the cave wall.

Compass, prismatic. O

Essential for mapping, orienting and pinpointing a position on a scale map. The War Office manual of map-reading will give the essential methods of map-making. Old editions are easily obtained. (See Alidade.)

Cork-lino, etc. S

Flat slabs of lino, soft plywood, wall-board, etc., up to 8″ x 4″, are sometimes needed for mounting fragile objects for packing, such as slate or ivory. Collector's pins, sticky-tape, etc., will hold the specimen, bottle-corks will act as spacers, and tissue-paper and cotton wool as packing, once a suitable box is found.

Dustpan, excavator's. C

Extremely useful for collecting brushed up soil for sieving. It consists of a sheet of $\frac{1}{16}$″ metal, about 12″ x 10″, with one end and two sides turned up. The elbow-piece is of the same metal, 15″ x 3″, slightly curved to fit the elbow and for necessary strength. The grip is a four-inch section of 1″ wood, bored to take a $\frac{1}{4}$″ bolt, which holds the dustpan together. It is a comfortable one-handed shovel, leaving one hand free to brush. (Fig. VIII. 4.)

Exposure meter. G

Essential for open-air sites, but seldom of any value in a cave. The photo-cell meters do not react at all for low light values, and the direct-visibility types are better.

Geologist's hammer. O

Most of its uses are covered by Picks and Hooks (q.v.).

Gummed labels. G

Useful for affixing to small boxes. They generally peel off in sunlight. Reference to note-book is essential.

Haversack. O

A military large-pack, fitted with shoulder straps, is needed for open sites. Collecting bags (q.v.) are better than subdivisions.

Hooks. G

Of $\frac{1}{4}$″ steel rod, mounted in wooden handles, are useful for digging, loosening soil, turning rocks, searching, etc. The interrogation mark about 6″ in diameter (Fig. VIII. 3.) and a 3″ right-angled bend are best shapes.

Inks, waterproof. G

For marking finds. Use a stainless steel nib with fine ball-point. Black is best, blue or red waterproof will serve on certain specimens. Decide on code of markings and keep to it. Grid markings are best.

Jack-knife. G

A scout-knife with marlin-spike is useful. See that blade and spike are firm in the handle.

Jacks. S

A car-jack is often useful to raise rocks for under-pinning or removal. Should be floored on sleepers, etc., to protect any underlying deposits.

Jumper drill. S

A strong steel drill, generally with cruciform section, for drilling holes for explosives. Blasting needs a certificate of proficiency. Wooden plugs hammered into position when dry, then wet to induce swelling, are said to split most rocks. I have not tried either method. Rock fallings seldom need blasting, which destroys stratification.

Knitting needles. C

Useful for excavating, cleaning up small stuff *in situ*. Coarse tweezers may also prove useful.

Labels. G

Labels to go in bags, etc., are best made of scrap ledger, cartridge or similar paper. Cut-offs can generally be begged from a printer. Every object or group should be accompanied by a label with note-book reference. A gross of 1″ price tickets is often useful.

Labels, tie-on. G

Artillery labels or identity discs of grey pressed board with two holes, will take waterproof ink, and are extremely useful for labelling bags.

Lamps. C

The acetylene mining lamp with concave reflector is a good standby. A storm lantern is excellent if camping, but a benzine, petrol or paraffin vapour lamp with mantle is better. Take spare mantles and prickers. Acetylene bicycle lamps, or headlights fed from a car, are useful for inspection. Magnesium battery-fused globes may be used for flashlight photographs.

Level, sliding. C

Described in text (page 110. See Fig. VIII. 1.)

Maps. O

Large-scale Survey Maps of the locality are needed, and if in constant use a further enlargement of the area near the sites should be made. Contours are essential for the study of river gravels.

Note-books. G

Use reporters' note-books with stiff cover for field work, as they fit the pocket. Use the same note-book again and again for a site. For writing up work, the loose-leaf or the quarto carbon book are best. The latter permits notes to be posted to headquarters for suggestions or for safety. The field-work book should be more complete than the notes taken on the spot, and intelligible to others. It must be written up while detail is fresh in the mind.

Numbers, letters, etc. G

Uncial or 72 pt. letters printed on 2″ cards or cut from commercial calendars, are useful for numbering photographs. They should be photographed in an inconspicuous place. Keep a record of all photographs in a note book. Numbers and letters may be made to slide into the grooves of a miniature "hymn board". Also acts as a scale.

Pencils. G

Ordinary HB or B graphite for marking specimens and taking notes and sketches. Indelible pencil or ordinary ink will not stand up to rain. Indelible pencil can be used for marking calico bags only.

Photographic mirror, or prism. S

Useful for perpendicular photographs, as it permits use of focusing screen. A surface-silvered mirror of polished plate glass is used, but yellows quickly, reducing photographic light. Constant resilvering is necessary. A prism would probably work better. Remember that the photograph is a mirror image, and must be reversed in printing the negative.

Pick. O

A light hand-pick of ¼″ sheet metal, 8″ long and 2″ wide, one end pointed, and the other chisel or fork shaped, and mounted on a ⅜″ steel shaft in a wooden handle, is sometimes useful. (Fig. VIII. 2.) It must be of tempered steel. A geologist's hammer is just as useful. I find the Hook (q.v.) is all that is needed. A rake is sometimes useful in windblown sand or loose earth on an open site.

Ranging Pole. G

Generally of one inch square wood, and four or six feet in length. It is marked off in feet, red and white, or black and white alternating, so that it is clearly visible over the alidade sights, and photographs well.

Shovel. C

One or two shovels are needed for cleaning up sifted soil only. Local farmers will generally lend shovels and labour in exchange for the soil.

Sieves. G

The ordinary Spanish 15″ circular sieve will answer all purposes for open sites. The holes should be of appropriate size.

For cave work a nest of sieves should be made of Clintoncloth (wire mesh). The largest sieve should be the size of the other two together, and should have six strands to the inch (⅛″ holes). The two smaller sieves should have 16 holes to the square inch and 9 holes per square inch respectively. A fourth sieve with one-inch chicken wire is useful for midden sites to remove shells and pebbles from the material. The largest sieve should be 4′ x 3′, the others 2′ x 3′ approximately, made to fit the frame of the biggest; this makes transport easier.

Sieve-frame. C

A solid erection to hold the fine sieve, and yet permit the necessary shaking, is useful when practicable. It should be built on the spot from poles, etc. If this is used it is necessary to have a small "gate" at the end of the sieve for clearing refuse. The sieve should be held level at about table-height above ground level. Material can be sifted into the fine sieve with Spanish sieves.

Sketching blocks. G

The reporter's note-book is best for field sketches, but they should be drawn to exact scale while memory can be relied on to fill gaps. A 1″ lightly ruled graph paper is useful for a first sketch but must be redrawn for publication. Blocks should be protected in a linen or canvas cover.

Sledge-hammer. S

Useful for breaking rock-fallings after they have been jacked up clear of deposit, and held on sleepers, etc. Look under the rock first in case there are paintings. The hammer can be borrowed.

Sorting sieve. G

I find a sieve of fly-mesh copper wire extremely useful for sorting dirty material. It is placed wire upwards and used as a table. If soil samples are needed, these can be collected on a clean sheet of paper underneath, changing the paper after each layer has been cleaned and sorted. This considerably reduces dust.

Sticky-tape, pins, etc. S

Cellulose sticky-tape is useful for packing and sealing, but is also useful for repairing objects on the spot. Permanent repairs must be made later, as sticky-tape tends to "creep" under strain.

Tackle. S

Pulleys, chains and ropes, etc., may be needed in conjunction with a stout tripod of poles for rock fallings. Winches, etc., can usually be borrowed from a farmer.

Tape measure. G

For open sites 25 to 50 yards. For shelters a yard or metre. Should be photographically clear, and kept clean. Lay this horizontally or vertically, never diagonally or radially from the lens when photographing.

Tent pegs. G

These or steel meat-skewers are necessary for holding tapes, lines etc. for levels and grids.

Test-tubes. S

A dozen 4″ test tubes an inch in diameter with corks and some means of packing, are useful for soil-samples, etc. Ash, pollen, ochres, and such can be collected for analysis. Label outside and inside.

Trowel. C

An 8″ or 6″ bricklayer's pointing trowel is the most useful tool of all. It will cut, search, probe, scrape and clean with the maximum control. This and the dustpan are constantly in use.

Twine. G

Garden twine, tenpenny-nails and pegs are needed for marking grids and base-lines. If the twine does not stretch, mark yards on it by tying in coloured cotton, etc. Cotton cord stretches too much and reacts to damp. An odd ball of string for labels, for closing bags, tying packing round long-bones, and so on, is useful.

Wood-wool, cotton waste, zostera, etc. G

Excelsior or other wood wool from fruit packing, waste sacking, hessian, cotton-wool or waste, are all useful for packing, and zostera (sea-grass) can sometimes be got at the coast.

Wrapping paper. G

Newspaper is most useful in quantity for packing. Tissue paper, corrugated cardboard, etc., for delicate materials. Everything should be packed carefully for travelling, as even the hardest implements can be chipped in transit. The middle of a car is most kind to delicate objects.

Yard-stick. G

The carpenter's folding rule is best for yards and inches, and the two-foot size is most convenient. It can be photographed. A self-straightening steel-tape in a small steel container, is very useful but will not photograph well. A dressmaker's tape measure or a stick painted alternately in black and white will photograph excellently, and is also useful in making a plane-table map.

XVI.

BIBLIOGRAPHY.

The paper bullets of the brain.
Much Ado. II. iii.

The following sources are given as a selection that I have found useful; the list is by no means exhaustive, nor are the headings to be regarded as in any way exclusive. Many works throw useful light on a variety of aspects of prehistory, and each is generally listed only once. While certain books might be regarded as "out-of-date", they are often the best source-books for particular aspects of prehistory, and show initiative and understanding.

A. *Scope and Approaches.*

Manuel de Recherches préhistoriques. (Paris, 1929).
CLARK, J. G. D. *Archaeology and Society.* (London; Methuen 1939).
CRAWFORD, O. G. S. *Man and his Past.* (Oxford, 1921).
DE PRADENNE, V. *La Préhistoire.* (Paris, 1938). Translated as *Prehistory.* (London, 1941).
FORDE, Daryll. *Habitat, Economy and Society.* (Methuen: London, 1937).
GOODWIN, A. J. H. *Communication has been Established.* (Methuen, 1937).
SOLLAS, W. J. *Ancient Hunters.* (London, 1924).
WOOLLEY, Sir Leonard. *Digging up the Past.* (London, 1930. Penguin books, 1939).

B. *Materials of Prehistory.*

GOODWIN, DRENNAN and SCHOFIELD. "Oakhurst Shelter". *Trans. Roy. Soc. S. Af.*, XXV, 1938 pt. iii.
GOODWIN and MALAN. "Archaeology of the Cape St. Blaize Cave and Raised-beach". *Ann. S. Af. Mus.*, xxiv, 1935.
SCHOFIELD, J. Various papers on pottery in *S. Afr. J. Sci.*, and in *S. Rhod. J. Sci.*, also in FOUCHE, *Mapungubwe*, listed below under M.

C. *Interpretation of Records.*

Physical Anthropology.

DRENNAN, M. R. *Introduction to Physical Anthropology.* (Cape Town, 1938).
KEITH, Sir Arthur. *The Antiquity of Man.* (London, 1925).
New Discoveries relating to the Antiquity of Man. (London, 1931).
STIBBE, E. P. *Physical Anthropology.* (London, 1930, and subsequent edition). Particular papers on physical anthropology by DRENNAN, DART, BROOM, GEAR, WELLS, GALLOWAY, ORFORD, etc. should be sought in the various journals listed in chapter XII, above, and in FOUCHE, Mapungubwe, etc.

Pollen Analysis.

CLARK, J. G. D. *Archaeology and Society.* (London, 1939).
ERDTMAN, G. "Pollen Statistics". *Science.* Vol. 73, 1931. *An Introduction to Pollen Analysis.* (Wlthm, Mass: Chronica Bot. Co. 1943).
GODWIN, H. "Pollen Analysis, etc." *New Phytogr.* Vol. 33, 1934.
McCURDY, G. G. (editor) *Early Man.*—Papers by SEARS, P. B. on Pollen analysis, and by BAKER, F. C. and RICHARDS, H. G. on land and freshwater molluscs. (Philadelphia, 1937.)

D. Technology.

GOODWIN, A. J. H. "Some developments in technique during the Earlier Stone Age" *Trans. roy. soc. S. Afr.* xxi. 1933 pp. 109-124.
HOLMES, W. *Aboriginal American Antiquities.* Bureau of Amer. Ethnol. No. 60, 1919.
KNOWLES, Sir Francis. H. S., "The manufacture of a flint arrowhead by quartzite hammer-stone". *Occ. Papers on Technology.* No. 1. Pitt-Rivers mus. Oxford.
MASON, Otis. *Origins of Inventions.* (London, 1895).
POND, Alonzo, in *Logan Museum Publications,* U.S.A., No. II, pt. i. 1930.
ROTH, W. E. *North Queensland Ethnography.* (Brisbane, 1903). This is the most important study of an actual stone-age people. It is essential for understanding what happens on a factory-site.
WARREN, S. H., in *J. roy. anthrop. inst.* XLIV. 1914.

E. Methods in the Field.

BURKITT, M. C. "Archaeological Methods". *S. Af. Journ. Sci.* xxiv. 1927.
GOODWIN, A. J. H. "On some problems of association and chronology". *S. Af. Journ. Sci.* xxviii. 1931.
LOWE, C. van Riet, "Preliminary report on the stone huts at Vechtkop". *S. Af. Journ. Sci.* lvii, 1927.
MALAN, B. D. "Some Problems of the Stone Age in South Africa". *S. Af. Journ. Sci.* xxxix. 1942.
"Excavation methods in South African prehistoric caves". *S. Af. Mus. Assoc. Bull.* Dec. 1944.

F. Geological Data.

DU TOIT, A. L. *Geology of South Africa.* (Edin. 1939).
GEIKIE, J. *Earth Sculpture.* (London: Murray, 1909).
KING, L. C. *South African Scenery.* (Edinburgh, 1942).
LOBECK, A. K. *Geomorphology.* (McGraw-Hill: 1939). Especially pp. 239-241.
MARR, J. E. *Scientific Study of Scenery.* (London, 1926).
O'BRIEN, T. P. (Listed under L. below, contains important material on tilting.)
SOHNGE, VISSER and LOWE. "Archaeology of the Vaal River Gravels". *S. Af. Geol. Survey.,* Mem. 35. 1937.
WRIGHT, W. B. *Tools and the Man.* (London; Bell. 1937).
Handbook to the Stone Implement Collections in the *British Museum.* (London, 1926).

G. Prehistoric Art.

BROWN, Baldwin. *Art of the Cave-dweller.* (London, 1928).
BURKITT, M. C. *South Africa's Past in Stone and Paint.* (Camb. 1928).

GOODWIN, A. J. H. "Vosburg: Its Petroglyphs". *Ann. S. Af. Mus.* Vol. xxiv. pt. iv. 1936.

LOWE, C. van Riet, *Prehistoric Art in South Africa.* (Bureau of Archaeology, Johannesburg, Arch. Series, No. 5. With Map.)

OBERMAIER and KUHN, *Buschmannkünst: Felsmalereien aus S. W. Afrika.* (Translation in English, Oxford, 1938.)

PARKYN, E. A. *Prehistoric Art.* (London, 1915).

STOW and BLEEK. *Rock Paintings in South Africa.* (Methuen: London, 1931).

More Rock Paintings in South Africa. (Methuen: London, 1938).

VON LUSCHAN, F., in *Zeitschrift für Ethnologie.* (Vol. LV, 1923, pp. 31-40).

WILMAN, M. *Rock engravings of Griqualand West.* (Camb. 1933).

The German Journal IPEK had many excellent articles on Prehistoric Art.

H. Survey Methods.

CRAWFORD, O. G. S. *Man and his Past.* (Cited above, A). An excellent approach to general survey methods.

FOX, Sir Cyril. *The Personality of Britain.* (Nat. Mus. of Wales. Cardiff, 1939).

GOODWIN, A. J. H. "The bored stones of South Africa". *Ann. S. Af. Mus.* (Still in press).

KROEBER, A. L. "Cultural and Native Areas of North America". *Univ. Calif. Publ.* No. 38, 1939.

LOWE, C. van Riet. "The Smithfield Industry in the Orange Free State". *Ann. S. Af. Mus.* xxvii, 1929. pp. 151-234. Still the best survey of a single industry in a limited area in South Africa.

SOHNGE, VISSER and LOWE. (Cited above, F.) A survey of a single river-basin.

The work by J. G. D. Clark, cited above, A. is also very useful.

I. Preservation.

RATHGEN, F., and others. *The Preservation of Antiquities.* (Camb. 1905).

Manuel de Recherches Préhistoriques. (Cited above, A.)

Later material than 1905 can be obtained from Clark (Cited above, A.) or from such periodicals as *Nature*, the *British Dental Journal*, and from various publications on museum method, mainly German and American. A series of recipes should be collected in an index for easy reference, indexed under appropriate uses: ivory, pottery, etc.

J. Bibliographies.

GOODWIN, A. J. H. "A commentary on South African Prehistory, with full Bibliography". *Bantu Studies,* Witwatersrand University, 1935, Vol. IX, pt. iv.

SCHAPERA, I. *Select Bibliography of South African Native Life and Problems.* (Oxford, 1941).

These two reference books, used in conjunction with the specific bibliographies occurring in the various sources mentioned here, will provide a very complete series of useful works on different aspects of prehistoric archaeology.

K. The European Field.

PEAKE and FLEURE. *Corridors of Time.* (Oxford, 1927) Vols. I and II especially.

BURKITT, M. C. *Prehistory.* (Cambridge, 1925).
Our Forerunners. Home Univ. Lib. 1923. (resumé of the above).
The Old Stone Age. (Cambridge, 1933).
Our Early Ancestors. (Cambridge, 1929).
DAVISON, D. *Our Prehistoric Ancestors.* (London, 1926). Also various other books.
HAWKES, J. and C. *Prehistoric Britain.* Pelican books, 1943.
LEAKEY, L. S. B. *Adam's Ancestors.* (London, Methuen, 1934).
PLANT, E. *Man's unwritten Past.* (Oxford, 1942).
CLARK, J. G. D. *Prehistoric England.* (London: Methuen, 1940).

L. The Protohistoric Field.

CATON-THOMPSON, G. *Zimbabwe Culture.* (Oxford, 1931).
FOUCHE, L. *Mapungubwe*: An ancient civilisation on the Limpopo. (Cambridge, 1937).

INDEX.

Roman figures refer to chapters. Words in brackets give alternative references.